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ELECTRICAL EXPANSION.

The annual report of the Western Electric Company is a remarkable document in its revelation of extraordinary growth. In 1906 the corporation did a gross business of $44,145,573. Last year its output reached a value of $69,245,331, showing a gain of 56.9 per cent for the twelve months. This was done on a capitalization of $15,000,000, so that the company turned its entire capital over every three months. Only ten years ago, namely in 1897, its output was $8,775,368, and the jump to the figures of 1907 indicates an increase of very nearly 700 per cent. Such statistics are hard to match in the electrical field or out of it, and are largely explained by the wonderful utilization of the telephone. It is understood that 80 per cent of the output of the company is telephonic, the remainder being of a general character in dynamos, motors, annunciators, line material, cables, etc.

President Barton gives expression to his belief that such a rate of growth cannot be maintained. The average rate of annual increase in the electrical field has been about 20 per cent, and even that involves a rapid compounding. But it seems difficult to believe that the company can show an output of $100,000,000 this year. To maintain the figures of last year would be doing well, and $75,000,000 would be a business worth doing. Of course the increased cost of copper, labor, etc., swells the total and probably a better profit could be made on a smaller output, with less overtime in it. Yet after all is said the figures give encouragement as to the future of electrical industries, skilfully managed and producing articles of necessity for the growing wants of modern civilization. There are three manufacturing concerns already in the electrical field doing a business of this magnitude. There could easily be a dozen, with a lot of business left over for others.

MOTOR-CONVERTERS.

A development of considerable interest is embodied in the motor-converter, a description of the constructional features of which is given on page 348 of the present issue. The operating characteristics of this machine were discussed at some length in our issue for October 21, 1905. The machine consists of an induction frequency converter directly connected, both mechanically and electrically, to a synchronous converter. It may seem remarkable that the machine, while quite generally employed in England, has practically been ignored in this country. The reason for the attitude of the American manufacturers and operating engineers with reference to the motor-converter is perhaps to be found in the fact that the conditions under which the machine operates most advantageously as compared with the rotary converter are less frequent in this country. It is admitted by the advocates of the motor-converter that for use on 25-cycle polyphase circuits the machine is inferior to the rotary with reference to first cost and running expenses, although it possesses some desirable features in connection with its characteristics under starting and operating conditions. On account of the fact that a very large proportion of the power

used with alternating-current converters in this country is obtained from 25-cycle circuits, it is apparent that the motor-converter must necessarily find a more limited field for application in America than in England, where a frequency of 50 cycles is often used for general power purposes.

The Wane of the Old Standard Incandescent Lamp.

We hear much these days of new higher efficiency incandescent lamps and of the probability that except in very small sizes the common, old-fashioned carbon filament lamp will before many years be a thing of the past. And yet, as a matter of fact, we see relatively few of these new high efficiency illuminants in use because of the comparatively small number of the lamps that have yet been turned out by manufacturers. However, there is at least one striking indication that a change in the art is upon us, namely, the present scarcity of old style standard 32 and 50-cp lamps, due to the fact that makers are getting ready to discontinue their manufacture. The lamp manufacturers announced their intention some time ago of discontinuing the manufacture of the old common carbon filament lamp in sizes of over 100 watts because of the advent of the new graphitized filament lamp now commonly known as the Gem lamp, which latter, because of its higher efficiency, would be certain to supplant the old standard lamps even if the manufacture of the old lamps was not discontinued. The position of the man who has an installation of standard 32-cp lamps with standard shade holders and who must substitute the new Gem lamp, which is considerably larger in bulb and longer in neck than the old standard 32-cp lamp, is not a comfortable one. The new lamp, as made, requires special shade holders when they are fitted with reflectors. The old standard shade holders leave the shade "high and dry" above the lamp bulb, resulting in a ludicrous appearance, and defeating most of the purposes for which the shade may be intended. If the change to larger bulb lamps requiring different shade holders causes the owner at the same time to change to glassware which is suited to the purpose of most efficient illumination, the change in lamp sizes will have been a good thing aside from all questions of lamp efficiency.

Dynamo Sparking Characteristics.

The phenomenon of sparking at a commutator seems to have been noticed, in some way, by Faraday, and ever since direct-current dynamos have been built with commutators, those commutators have been liable to troubles from sparking. It has always been a relatively easy matter to design and predetermine the voltage characteristics of a direct-current dynamo or to ascertain what dimensions, speed and excitation would be required to generate an assigned voltage. It has, however, always been more difficult to predetermine the sparking limits of such a machine, or to say beforehand how much current the machine could carry at its commutator without sparking seriously. The danger of excessive sparking within the limits of rated load current has been the spectre at many a designer's table. Only within recent years has light been thrown upon this complicated phenomenon of commutator sparking to such an extent as to permit of the use of reasonably reliable formulas for assigning the sparking limits. Even now the data we possess are by no means complete. The sparking is essentially a phenomenon of self-induction. The same principles which produce useful sparking in a gasoline or gas engine, with the aid of a voltaic battery and induction coil, also give rise to the objectionable sparking at a dynamo commutator by reason of the self-induction of the armature coils undergoing current reversal. The limiting current strength that can be quietly reversed depends upon the amount of magnetic flux linked with that current in the commutated coil, and the spark with which that flux has to be reversed. Magnetic flux objects to being reversed, and this fact is now believed to underlie not only commutator sparking and induction coil sparking, but also the mechanical inertia of mass or matter.

It has recently become customary to treat the phenomenon of commutator sparking from the standpoint of alternating currents, and to consider an armature coil as subjected to a certain frequency of alternation, which is called the commutation frequency, and which is determined by the number of commutator segments passing each brush, or brush holder, per second of time. The inductance of the armature coils being known, or computed, their reactance in ohms, at the commutation frequency, is found. This reactance gives rise to a certain voltage drop, when the normal rated current passes through the coils. If this voltage, called the reactance voltage, exceeds a certain empirical limit, say ten volts, serious sparking may be expected at the commutator, at rated load. If, however, the reactance voltage is well below the accepted limit, the machine may be expected to carry its full load, or even an overload, without serious sparking. The article by Mr. Carlton L. Kennedy, on page 344 of this number takes up this question of determining the limiting commutating current from the standpoint of reactance voltage, but seeks to carry the process a step further. It considers the effect of armature currents on the distortion of the magnetic flux distribution, and the additional flux which has on this account to be withdrawn from the coil during commutation. It also considers the influence of a displacement of the brushes from the neutral points. In the practical example considered the reactance voltage limit is taken as 10 volts, the reactance of each armature coil as approximately ⅛ ohm, and the extra virtual reactance due to distortion 0.157 ohm, or more than the normal reactance. It would seem, therefore, that if the distortional effect of the armature were neglected in the commutation, the limit of reactance voltage would have had to be decreased from 10 volts to 4.4 volts. It becomes, therefore, important to check such formulas in as many cases of actually tested dynamos as possible, in order to determine how far they may be safely depended upon.

Investigation of Light-Standards.

A paper on this subject by Mr. Clifford C. Paterson, before the Institution of Electrical Engineers, has recently appeared in the London *Electrician*, an abstract of which appears in the Digest. It contains interesting photometric data on the comparison of three flame standards of light, viz.: the British Pentane, the French Carcel and the German Hefner. The paper contains a report on the results of a number of researches conducted at the British National Physical Laboratory on these luminous standards. The relative advantages of the three types are compared. The conclusion is indicated that while the Carcel lamp gives a convenient magnitude and color of light, it is unsatisfactory in regard to steadiness, uniformity and reproducibility, mainly owing to variations in the capillary action

of the wick. The Pentane and the Hefner are superior in these respects as primary flame standards and of the two the 10-candle Pentane is preferred on account of its color, magnitude and convenience. The paper tabulates four series of comparisons between the Pentane, Hefner and Carcel as reported by four different standard laboratories in Europe. The Pentane candle varies, according to these, from 1.076 to 1.093 hefner, with a mean value of 1.084 hefner. The effects of variation in barometric pressure, humidity, carbonic dioxide and oxygen on the value of flame standards are considered. It is pointed out that the effect of ordinary carbonic dioxide variations are negligible on both Pentane and Hefner lamps. The effect of barometric pressure, oxygen shortage or humidity cannot, however, be safely neglected. The correction in the Hefner for barometer is 0.011 per cent for each millimeter of mercury above or below the standard reading of 760 mm., the Hefner lamp giving more light as the barometric pressure increases. The correction for the Pentane is 0.08 per cent per mercury millimeter, or about seven times larger than the Hefner correction, and in the same direction.

As regards humidity, or water vapor, the correction quoted for the Hefner is 0.55 per cent for each liter of water vapor per cubic meter of dry air, above or below a normal allowance of 8.8 liters per cubic meter, or about 0.9 per cent of vapor by volume. The corresponding Pentane correction is given as 0.66 per cent for each liter of water vapor per cubic meter of dry air, above or below a normal allowance of 10 liters per cubic meter. In each case an increase in humidity diminishes the light emitted by the standard flame. The reason for taking 8.8 liters per stere as the standard humidity for Hefner air and 10 liters per stere for Pentane air is attributable to the fact that the Hefner correction was worked out from observations near Berlin, and the Pentane correction from observations near London, the British climate and atmosphere being, on the average, more watery. It is clear from these data that on a moist day in summer a Hefner or Pentane standard might give one or two per cent less light than on a dry day in winter, especially within a furnace-heated building. The effect of oxygen deficiency seems to be serious, although the actual correction formula does not appear. It is evident that a photometer room using flame standards should be thoroughly ventilated and yet screened from draughts. Although correction factors for primary flame standards are important, it would seem doubtful whether we shall ever be able to swear to a flame standard of light within less than one per cent.

THE ISOLATED PLANT AS NON-PEAK LOAD.

We have frequently called attention to the possibility of central stations securing isolated plant owners as customers for a part of the year or a part of the day. The general policy of central station companies has been to prevent the installation of isolated plants if possible, and wherever they are installed to secure their complete abandonment rather than to enter into any agreement for carrying their load part of the time. Some managers, however, have begun to realize that there is such a thing as making good profit and also saving money for the customer by taking the isolated plant load at times when it costs more to operate the plant than purchase current for the central station, allowing the isolated plant to carry the load during the winter peak and perhaps during the entire steam-heating season, thus relieving the central station of the investment necessary to supply current during the peak load period in December. Many managers approach the owner of the isolated plant in a spirit of antagonism to the whole proposition of operating a separate plant, whereas the proper way to start such negotiations is in a spirit of co-operation with the owner of the plant to see whether there are not certain periods when he could well afford to shut down his plant and other periods when he could well afford to run it.

As is well known, the use of exhaust steam for heating a building or for manufacturing purposes makes the cost of producing electrical energy in the case of many isolated plants so low that the central station company in order to meet this cost must make an unprofitable rate when the fixed charges on the investment necessary to carry the winter peak load is considered. It can, however, afford to carry such an isolated plant at times of the year when steam heating is not necessary at a lower rate than it could make for the entire year's business. This may seem something of a paradox, but is simply due to the fact that a load of this kind carried during the summer months only is purely non-peak business, because the central station is never worked up to its full capacity during these months. The effect of such load on the central station is to improve its load factor and so reduce its costs per kw-hour. We have in mind one company which has some twenty isolated plants in the down-town district of a large city, for which it carries the load during the summer season. In this way it has been able to make a marked change in its load factor, and for the past year has increased its kw-hour output notably more than its peak load, which, of course, is one of the objects all central stations are striving towards in order to make their investments more profitable.

Looking at the matter in this way, it is a question whether the existence of certain classes of isolated plants in a city is not desirable from the central station man's standpoint, because they keep down the central station investment necessary to carry the winter peak loads. Besides the plants which can be shut down in summer only there is another class of isolated plants which can be operated with profit only during the peak of the lighting load every evening. Such plants can be connected with central station service during the balance of the day with profit to all concerned. A central station in a large city with the usual high distribution system investment is seriously handicapped when it comes to making a rate for peak load business which will compete with an isolated plant with no distribution system investment, even though the operating cost per kw-hour of the isolated plant may be much higher. On peak business it is the fixed charges rather than the operating costs that make up the greater portion of the rate that must be charged for light and power. For other than peak load business the operating cost of the isolated plant is likely to be very high. While it is true that the operating cost of the central station is also higher during light load periods than during peak periods, it is also true that additional load during the light load periods adds very little to the actual total daily operating expenses of the central station, because the labor charges and fixed losses in generation are going on continuously without regard to whether a few kw-hours more or less are sold during the day.

The First Telephone Switchboard.

The following interesting letter is contributed to the Baltimore *Sun* by the veteran electrical manufacturer of that city, Mr. A. G. Davis. He says: "In your issue of Sunday, January 20, there appears a letter from Boston in which claim is made that Mr. L. B. Doolittle was the inventor of the original telephone switchboard. It is also stated that the first telephone switchboard was made in Boston at the shops of Mr. Williams, on Court Street, and placed in service in Bridgeport, Conn., in July, 1878. The foregoing, however, is not the fact. The first telephone switchboard was "made in Baltimore" by Davis & Watts, at 47 Holliday Street, in January, 1878, and was placed in service at Meriden, Conn., during the first week in February, 1878, six months before the Bridgeport (Conn.) telephone exchange was established by Mr. Doolittle.

"It was in the early part of the summer of 1877 that Mr. A. G. Davis introduced the Bell telephone to our Baltimore citizens. The first pair of instruments were given to Mr. E. D. Onion, the coal merchant on Second Street, connecting his office with his coal yard near the Belair Market. During that summer many other firms were connected by private lines. In March, 1878, the Baltimore Telephone Exchange was opened, and the same kind of switchboard was installed as was then in use at Meriden, Conn., and at New Haven, Conn. Mr. A. G. Davis visited Meriden and New Haven and took notes of the system introduced at those places by Mr. George W. Coy, who came to Baltimore and ordered exchange apparatus for Meriden and New Haven—the first two places in the world to adopt the telephone exchange system. At that time there was no transmitter, the receiver being used for both speaking and hearing. When the "loud-speaking," or battery transmitter, the invention of Mr. Blake, of Boston, was introduced, the first one made was placed in the Academy of Music, Baltimore, and connected to a private wire extending to the residences of the late Dr. Alan P. Smith, Edward Hambleton, Archie Wilson, Jr., J. H. C. Watts and A. G. Davis. At each of these residences many friends of Mr. Davis enjoyed the singing of Gerster, whose voice was heard over the line as distinctly as at the Academy.

"The firm of Davis & Watts, which was the predecessor of the present Viaduct Manufacturing Company, introduced many improvements in the telephone system; perfecting the magnetic bell for calling subscribers where formerly a battery bell was used."

Electrical vs. Mule Mine-Haulage.

In a paper presented before the Illinois Society of Engineers and Surveyors, Mr. M. F. Peltier gave the results of experience with an electrical mine haulage plant installed at No. 3 mine at the Peabody Coal Company, Marion, Ill. Prior to installing electric haulage, there were sixteen gathering mules and seventeen mules working in spike teams, pulling from the lyes to the shaft, producing 1,400 tons of coal daily. Owing to the size of cars, grade and average haul of 1,800 ft. from lyes to bottom of shaft, the output had reached its limit with mule haulage, and it was finally decided to install electrical haulage. Two fifteen-ton traction locomotives with double-end controller and trolley poles of the reversible type were installed, with No. 4-0 trolley wire, securely fastened to roof with trolley hangers, eight inches outside of outer rail. Each locomotive is provided with two motors wound for 250 volts, and exerts a draw bar pull of 8,200 pounds on the level. They have pulled 17 loaded cars up a 2½ per cent grade, 1,200 ft. long. These cars weigh when empty 1,950 lbs., and hold on an average of 6,600 lbs. of coal, so the weight of a loaded train would be over 72 tons.

The track gauge is 42 in. The track measures 9,000 ft. over all and is laid with 40 lb. T rails, bonded and cross-bonded for the return current. The coal is all caged on one side, and the empty cars taken off on the other. The electrical power for operating the motors in the mine is supplied by a 175-kw generator belted to a 200-hp McEwen high-speed engine, located in the power house department of the building containing the hoisting engines. The generator also furnishes light for the underground haulage ways. From the switchboard in the power house the current is transmitted over a 400,000 cir. mil cable running down the manway and to the main haulage way of the mine.

The entire electrical equipment, including generators, cost $21,172.79. The average cost of hauling with mules was 2.4 per ton mile, and with electricity is 1.4 cents, the latter figure taking account of interest on investment, depreciation and taxes, while 2,000 tons of coal are daily handled instead of 1,400 tons, which was the limit of mine capacity with mule haulage.

February Meeting of the New York Section of the Illuminating Engineering Society.

At the meeting of the New York Section of the Illuminating Engineering Society, held on February 8, the following section officers were elected for the ensuing year: Mr. Albert E. Forstall, chairman; Messrs. Manning K. Eyre and T. R. Beal, managers; and Mr. Preston S. Millar, secretary. The paper of the evening was one on the photometry of incandescent gas lamps presented by Mr. Thomas J. Little, Jr., of the Welsbach Company, dealing with photometry from a practical standpoint, and avoiding all theoretical discussion of instruments and devices.

A complete description was given of the equipment required in the photometer room and many suggestions were made concerning the precautions which must be taken to insure accurate measurements. The author stated that satisfactory results had been obtained from the pentane lamp of the Harcourt type as a standard of illumination; it is simple and transportable. Pentane of proper specific gravity may now be obtained readily, and the pentane lamp in its present form is perfectly safe. If a complete equipment of testing instruments, storage batteries, master standards, standards and sub-standards are available, the incandescent electric lamp is well suited as a standard of illumination.

The author of the paper expressed his preference for a modified form of the Dibdin radial photometer. With this photometer the lamp the light of which is to be measured is suspended from the horizontal bar which slides between a pair of uprights. A radius rod is connected to the sight-box, which is mounted upon a table, the latter traveling on a track along the floor. The standard is mounted on a carriage which may be moved along the track on the table. Radial readings can be made through 180 degrees in a vertical plane, and, by shifting the burner, 180 degrees in the horizontal plane. Many suggestions were made as to the best methods to employ in calipering a mantle in order to determine the amount of shrinkage during its life. The importance of using throughout the test a uniform quality of gas at a constant pressure was discussed at great length and illustrated by means of curves showing the results of actual tests.

The discussion was opened by Mr. W. C. Morris, who said that the numerous precautions mentioned by the author are absolutely essential if reliable results are to be obtained. He stated that discrepancies in results from tests made under what seemed to be exactly similar conditions were found to be attributable to the change in temperature of the air surrounding the pipe through which the gas was led to the lamp. Although the error in reading the setting of the photometer may be decreased by using a long photometer bar, there are conditions under which it is advantageous to employ a short bar. Thus when the lamps under test are of small illuminating values it is desirable that the distance between the lamp under test and the standard be not too great. The lamp should in all cases be screened from both the disk and the eyes of the observer.

The observer should make readings on both sides of the bar in order to eliminate any error due to unsymmetrical vision.

Mr. V. R. Lansingh called attention to the fact that all of the equipment described by the author, and the walls of the room in which the photometer apparatus was placed, were painted black. He remarked that the precaution in this respect would be unnecessary if the proper number of screens were used. At the Bureau of Standards the photometer rooms are equipped with white walls, and the rooms are very much more cheerful than those in which black walls are used.

Mr. Victor A. Rettich spoke of the advantages to be derived from standardizing both the mantle and the burner of an incandescent gas lamp. If standard burners are used, new forms of mantles can easily be compared with standard mantles. Likewise when standard burners are employed, special forms of mantles can readily be compared with standard mantles. He called attention to the fact that it is preferable to remove the collodion from the mantle by igniting from the bottom rather than from the top, in order that the ascending flame may thoroughly consume such gases as might otherwise produce a disagreeable odor.

Dr. Clayton H. Sharp spoke of the distribution of illumination around the incandescent gas lamp, and expressed the opinion that it is preferable to ascertain the intensity in all directions rather than in only one. The importance of such method of measurement will be appreciated when the inverted mantle lamp is compared with the more usual form of lamp. Although white walls can be used in the photometer room, provided the proper number of screens are placed along the photometer bar, more satisfactory results are obtained when the walls are black.

Mr. Preston S. Millar stated that the amount of fatigue of the eyes of the observer is much less when the walls are painted black instead of white.

In closing the discussion, Mr. Little remarked that the intensity of illumination in the horizontal plane is much more uniform with an incandescent gas lamp than with an incandescent electric lamp. Although observations of the intensity of illumination from one part of the burner does not furnish accurate information concerning the intensity at other parts, yet the difference is not very great and in a life test of a mantle it is preferable to make a series of observations of the illumination from a single section of the mantle. The real object in using screens along the photometer bar is to prevent the light from the lamps reaching the eyes directly, because it is difficult for the pupil of the eye to become adjusted rapidly to a considerable change in the intensity of illumination.

It was announced that the March meeting of the Illuminating Engineering Society will take the form of a symposium, at which the illumination of large interiors will be discussed.

Municipal Ownership.

Mr. Arthur H. Grant, editor of *Concerning Municipal Ownership*, gave an address before the Men's Club of Elizabeth, N. J., February 4 on the question of municipal ownership. A short time ago the citizens voted in favor of a municipal electric light plant, but the movement has been strongly opposed by many leading business men of the city. Last month Mr. Moody, publisher of *Moody's Magazine*, addressed the club, upholding municipal ownership, not because the city would get better service or lower rates, but because councilmen under present conditions seek election for the purpose of bleeding corporations. Mr. Grant spent very little time discussing the theoretical side of municipal ownership, but gave numerous examples of actual failures, and severely criticized the common practice of city officials in making reports in which proper charges are not included against the plant in order that a paper profit may be shown. He referred to the report of the British Institution of Electrical Engineers, which states that the present backward state of the electrical industry in that country is directly attributable to municipal ownership.

Some Characteristics of Alternating-Current Motors in which the Central Station Man is Vitally Interested.

At the convention of the Northwestern Electrical Association held in Chicago January 16 to 18, Mr. C. W. Bergenthal presented a paper which dealt specially with the torque and starting current of commercial single-phase and polyphase motors. The characteristic of alternating-current motors of most interest to central station men was stated to be the starting current, because on this factor depends the degree of success to be secured in supplying lights and power from the same distributing circuits. He showed a curve giving the relative starting torque and current of a polyphase motor with a squirrel-cage rotor as compared with a wound rotor, this data being taken from the 1906 edition of "Modern Polyphase Machinery," by Andrew Stewart. The squirrel-cage rotor requires between five and six times the full-load current to start it with full-load torque, while the coil-wound rotor will start at full-load torque with practically full-load current. The difference is even greater when more than full-load starting torque is required. The auto-starter or compensator used with a squirrel-cage rotor does not seriously reduce the current taken from the line, and is of no advantage except when it is desired to start the motor with some fraction of its maximum torque. Considering these facts, should not the central station man specify the respective sizes of squirrel-cage and coil-wound armatures which he will permit on his lighting circuits?

With single-phase motors there are two prevailing types on the market: the commutator or Wagner type and the split-phase or Tesla type. These two types of single-phase motors differ more in starting current than the two types of polyphase motors. The commutator type develops better torque per ampere at the instant of starting than the coil-wound polyphase motor; whereas the split-phase single-phase motor develops less torque per ampere than the squirrel-cage type of polyphase motor. It is evident from these figures that from the central station point of view the preferable types of alternating-current motors are the coil-wound polyphase motor and the commutator type single-phase. A given horse-power commutator type, single-phase motor will disturb the voltage less when operating off of one phase of a three-phase circuit than will a three-phase squirrel-cage type of motor. Between the years 1900 and 1906 the weights and overload capacities of polyphase motors have been reduced by keen competition. The 1906 motor has a power factor which is lower than the 1900 motor when used above its rated voltage. Assuming that the power factors of the two motors are the same on rated voltage unless the polyphase motor is overrated badly, almost any such motor will show excellent durability and cost little for maintenance.

In the discussion of Mr. Bergenthal's paper, Prof. J. W. Schuster pointed out that the difference in starting torque with the different types of motors was due to the fact that the Wagner motor in starting was a repulsion motor, whereas the other motors were induction motors. President Almert said that the general tendency seemed to be to use single-phase motors up to 5 or 7½ hp, and in some cases as high as 25 hp. Mr. Bergenthal quoted the operating engineer of a large company as saying that if customers could be persuaded to buy the more expensive single-phase motor his company would not connect to any polyphase motors of less than 15 hp. It is partly a question of the extra first cost of the single-phase motor to the customer. Mr. O. M. Rau, of Milwaukee, said that his company would connect to any single-phase motor that would not take more than twice the full-load current at starting. Three or four different makes of single-phase motors now come under that head. It does not limit the size of the motor except with reference to the district where it is to go. In some districts which have large feeders larger motors can be installed than in others. This point should be determined before a motor is installed. The elevator proposition is the most troublesome.

Titanium Filament Lamp.

A patent issued January 29 to John Allen Heany, of York, Pa., on an original application filed December 29, 1904, and decided November 27, 1906, describes the process of manufacture of a homogenous titanium incandescent lamp filament. The claims of the patent are on a filament made of pure metallic titanium "of high fusing point and electrically conductive, which is stable at an efficiency at which a carbon filament, or a titanium carbide filament, will rapidly disintegrate, the light-emitting properties of the filament being due to homogeneous nature of the titanium"; and on the process of forming the filament "which consists exclusively of a conducting titanium compound by passing therethrough an electric current in a vacuum, thereby illuminating the substance with which the titanium was combined with and by means of said electric current shrinking and sintering the remaining pure metal into a dense homogeneous shiny filament."

The specification states that the invention relates to the manufacture of luminants for electric lamps made of very pure refractory metals, such as tungsten, titanium, zirconium, etc., or alloys of two or more such metals, or of pure chromium, molybdenum, thorium, manganese, or alloys of such metals.

These luminants are ductile and capable of standing a much higher temperature than any form of carbon or the carbides of such metals, and are more efficient than any hitherto known metallic filaments. They can withstand a much higher temperature and also convert the heat into light waves, and thereby have the properties of selective radiation. These metals, or osmium, cerium, niobium, tantalum and vanadium, or boron and silicon are utilized, either singly or mixed in a powdered form, as some of these powdered metals can be obtained by known processes, more or less pure; or the pure oxides, hydrides, nitrides, or metals in a very fine powder or in a colloidal state of the oxide or colloidal suspension of the pure metal can be employed, and with the dry powder a lubricant or binder used, such as water or paraffin, to form or shape them. They are then baked in an oven to drive out the paraffin or water, and in case the oxide is used the filament is reduced in pure hydrogen by external heat to the metal. The preliminary baking does not oxidize the metal, but merely strengthens it, and during this operation the binder is dissipated, leaving the filament formed of a refractory substance, strong, durable, and of good conductivity. The body is now heated by an electric current in a vacuum to drive out the hydrogen and to sinter or alloy the particles. If the filament is too large or rough, it may be rolled or drawn to the desired shape.

As an illustration of a suitable process, titanium nitrides are produced, for instance, as the titanium dinitride ($Ti N_2$) by heating the pure titanium dioxide in pure ammonia-gas. The nitride is mixed with a very small percentage of water or paraffin and heated, as above described, to eliminate the water or paraffin, and the filament is then treated by an electric current in a vacuum to a sufficient temperature to decompose the nitride, and a dense homogeneous pure titanium filament results; or the pure titanium metal, in a very fine powder, is squirted into shape by means of a suitable lubricant, such as water or paraffin, heated gently to drive out all traces of the lubricant, and then sintered in a vacuum into a dense shiny pure titanium filament; or if desired, titanium dioxide is converted into the colloidal state and formed into shape, dried by gentle heat, and heated in pure hydrogen to reduce the filament into the metal, although in this last-named operation it is quite probable that some or nearly all of the titanium dioxide is merely reduced to the suboxid (TiO); but as this substance is a good conductor of electricity it is admirably suited for further treatment; or the titanium metal is converted into the colloidal state and formed into filaments, when in the desired consistency gently heated, and in both these last-described cases the filament is traversed by a suitable electric current in a vacuum to sinter and shrink the filament into a dense shiny homogeneous metallic filament.

The luminant bodies are to be used in a vacuum or neutral gas to prevent any possible oxidization of the metal, and give a greater light for the same expenditure of energy or the same light at a much less expenditure of energy than any form of electric luminant hitherto known. This wonderful and hitherto unknown efficiency may be attributed not only to the high temperature coefficient and the high temperature which the filament can withstand, but also to the shiny metallic surface of the luminant, which radiates the light-rays in a remarkable manner.

Should there be the slightest trace of carbon or of some easily-fusible metal like platinum present in the luminant body, its efficiency will be so reduced as to render the body almost useless. A trace of carbon may permeate the filament of the lamp during the exhausting operation if care is not taken to prevent the vaporized oil of the pump from entering the bulb of the lamp and combining with the titanium filament.

Recording Wattmeters.

Two patents recently issued to Messrs. J. Willis and L. F. Imlay as co-inventors, and to Mr. Imlay alone describe two

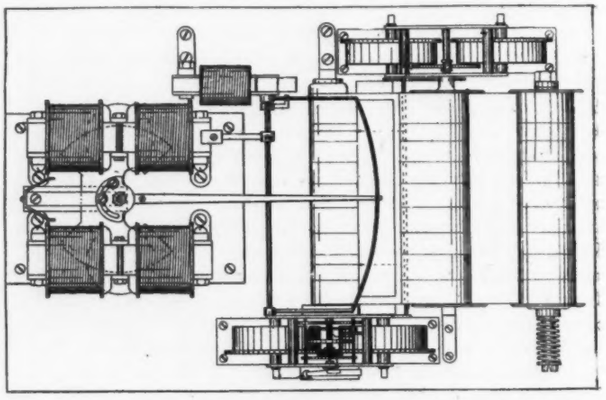


FIG. 1.—RECORDING WATTMETER DRIVEN BY CLOCK MECHANISM.

forms of instruments that can properly be designated as recording wattmeters, in contradistinction to watt-hour meters, which are sometimes, though erroneously, referred to as recording

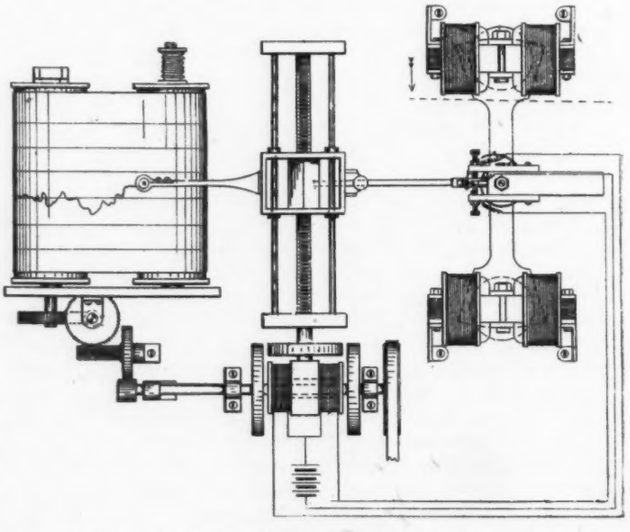


FIG. 2.—MOTOR-DRIVEN RELAY RECORDING WATTMETER.

wattmeters. Fig. 1 illustrates the wattmeters covered by the first patent mentioned above. The inventors employ two single-phase induction type wattmeters arranged side by side and

acting upon two wings of a secondary disc to which a pointer is attached. The pointer is equipped with a stylus which plays over a roll of paper driven at a uniform rate by means of a clock mechanism. Immediately above the pointer is arranged an arm which periodically strikes the pointer and causes an impression to be recorded upon the paper at a position depending upon the power in the system. This meter is intended for use on circuits which have no great momentary variation in power, such as those for incandescent lighting and general power service.

The meter illustrated in Fig. 2, which forms the subject of the patent of Mr. Imlay, is adapted for use where the power is subject to sudden fluctuations of considerable magnitude, as in street railway service. The meter is of the relay type, the actual driving force for both the recording stylus and the moving chart being obtained from a constant-speed motor. Current from a battery passes through one or the other of two magnet coils, according to whether the position of the stylus arm corresponds to a greater or lesser amount of power than that actually flowing in the system. The magnets, being energized, one of two friction discs are brought into contact with a driving wheel which imparts motion to the stylus in a direction to cause it to approach the position corresponding accurately to the power in the system.

Discussion on Illuminating Engineering at the Northwestern Electrical Convention.

Following the reading of the paper by Mr. J. R. Cravath, at the Northwestern Electrical Association in Chicago, January 17, which was printed in these columns in the issue of January 26, there was an extended discussion which brought out some interesting points. Mr. George Cutter advocated reducing residence electric fixtures to their lowest terms, so that they will not stand out in the room too prominently. In his house he uses bracket lamps, pointed up in many cases, for the general illumination. Over the dining-room table, however, he uses a fixture, and in the hall a ceiling lamp. These brackets should be as unobtrusive as possible. By pointing up the lamps on the brackets, the lamp filaments could be completely hidden by the shade or globe. Mr. Cravath agreed with Mr. Cutter that if general lighting in a room is to be accomplished by means of brackets, the lamps should be pointed up so as to get some reflected light from the ceiling.

Mr. F. W. Willcox thought there had been too much of a tendency to keep down the number of outlets. One of the greatest advances in illuminating work recently was in uniformity of lighting. If one can get uniform lighting lower intensity is permissible than otherwise. He gave as an example of good uniform lighting certain new rooms in Marshall Field & Co.'s store in Chicago. In this store the engineer took the precaution to lay out in each 21 by 22-ft. ceiling panel as many as six outlets, so that any combination of light desired can be secured. In this room, with ceilings 16 ft. high, with gem lamps in bowl holders scattered over the ceiling, the watts per square foot were 1.5 and the average illumination for nine stations was 3 foot-candles. The old arrangement used in the store of common incandescent lamps hung low on chandeliers took 1.25 watt per square foot and gave an average illumination at 15 stations of 1.3 foot-candles. Extreme variations in illumination for the old arrangement were .7 to 2 foot-candles, due in part to the shading effect of the goods in the store. The extreme variation with the new units on the ceiling was from 2.7 to 3.3 foot-candles. He wished to impress upon central station men the importance of having their engineers, solicitors and employes generally become familiar with illuminating engineering and with the units and terms used. The idea of what the foot-candle is should be as firmly fixed in the mind as a pound or a foot. With that as a start practical experience and tests will make us proficient in estimating and quickly calculating the amount of energy required to give certain illumination values. He mentioned an arrangement for turning ceiling lamps on and off individually, which has considerable application in some classes of work. A pull chain socket is used, one end of which is fastened by a screw eye to the ceiling. Then by means of a light rod with a hook on the end, the current can be conveniently turned on and off.

Mr. R. N. Kimball thought people had become accustomed to the kerosene lamp and therefore the portable electric lamp was desirable. Mr. Cravath said that people were reading with kerosene lamps because they got such poor results from the portable electric lamp. By clearing away the space in the middle of the room and sitting under the chandelier, thus getting away from the old idea of sitting around a table, the stand lamp could be abandoned altogether except as a decorative feature. One of the most efficient portable electric lamps is a converted oil lamp with a deep opal dome reflector, but the average portable electric is not efficient, and the best that can be done with it is to put a low-candle-power lamp in it and use it as a decorative feature.

Mr. F. W. Downs, of Washburn, Wis., said that his company kept a few portable lamps on hand and whenever they sold one to a customer, it was with the privilege of return. He got most of these lamps back as being unsatisfactory. He did not think any of his customers had had a lamp out more than a year. In his town the incandescent service has been so satisfactory that his company has never been able to introduce the arc lamp.

The Development of Telephony in Europe.

A number of U. S. consuls and consular agents have recently filed reports as to telephonic conditions in Europe. U. S. Consul-General A. W. Thackara, of Berlin, supplies the following information concerning the telephone systems of Germany: The telephone business in Germany is under the control of three separate administrations—the Reichs-Postamt, Berlin, being the controlling power for all of Germany, with the exception of Wurtemberg and Bavaria, where separate administrations control the telephone service. Until recently magneto switchboards and subscriber's apparatus have been in use in Germany. Within the last three or four years common battery switchboards and instruments have been introduced. Berlin is about to be transformed into a central battery system. There is in Berlin one automatic switchboard of the Strowger type, to which are connected about 90 to 100 subscribers. At the town of Hildesheim, in Germany, an automatic exchange for about 2,000 subscribers will shortly be opened. In Bavaria, subscribers' sets and switching apparatus are of the generator call type, with the exception of the towns of Ludwigshafen, Nuremberg, Fürth, Würzburg, and Neustadt, where common battery service is given. In Wurtemberg all exchanges are still of the magneto type, some of them being with automatic clearing out, but not with transmitter battery supplied from the exchange.

The apparatus used in Prussia is the government type, manufactured by twelve different manufacturers in Berlin. In Wurtemberg the magneto subscribers' sets are manufactured in the government workshop, whereas receivers and transmitters of a standard type are bought in the open market.

In Bavaria the apparatus in use are of a government standard type and are made by manufacturers in Bavaria. Manufacturers from other parts of Germany have not been able to do any business there. At the end of 1905 about 500,000 subscribers' stations were in connection with the telephone service of the Reichs-Postamt.

The number of telephones purchased annually amount in North Germany to about 50,000, in Wurtemberg about 3,200, and in Bavaria about 10,000. The service in the larger cities having individual exchanges on the central battery system is fairly satisfactory, and probably as satisfactory as it is in the larger cities of the United States.

Berlin is at present undergoing a transformation, on the com-

pletion of which it is expected to give service which will be up to that given in New York. In Hamburg a new large exchange is being built, which will give fairly efficient service, at an immense cost, however. The service in Munich is very good, probably equal to any given in the United States. In Stuttgart the service is not up to what would be given in a city in the United States, the city having one single exchange.

Consul J. I. Brittain, of Kehl, states that the telephone instruments used there are manufactured by the government at Berlin. In the Grand Duchy of Baden and Alsace-Lorraine it is stated that there are about 5,000 telephones in use, and about 200 new instruments are supplied each year. The rent for the telephones is collected by the post office officials quarterly in advance.

Consul Thos. H. Norton, of Chemnitz, reports that the telephone service, with 4,952 receivers in the city of Chemnitz, is the property of the city. Sixty-three neighboring towns are in close telephonic communication with Chemnitz, which employ an additional number of nearly 5,000 telephones.

Consul W. L. Lowrie, of Weimar, sends a report stating that $238,000 is about to be spent in that duchy for the improvement of the telephone service. Metallic circuits will be strung and connections made with many points. The improvements were planned by the government on account of the increase in the use of the long-distance lines.

Consul-General B. H. Ridgely reports from Barcelona that there are only three telephone companies of any importance in Spain. The apparatus mostly used comes from Paris and Stockholm, and is of the magneto type. The Barcelona company has in use 3,053 telephones, at an average rental of $55 each per annum. They also operate a subsidiary company, reaching—with 2,823 telephones—to other cities, while a third company, a branch of the Barcelona company, operates 2,440 telephones, with Madrid for a center. All told, these associated companies purchase about 525 telephones a year. They are energetic and growing, and will, probably, in the near future, take active steps to develop the long-distance system which, up to date, has been very little developed.

Consul D. W. Williams writes from Cardiff that the National Telephone Company, of that district, purchases about 1,000 instruments a year. Rural telephone systems, such as are used in America, are not known in Wales, only the well-to-do having telephones in their houses. The service is not as satisfactory, ordinarily, as it is in the United States, and the rentals are high.

CURRENT NEWS AND NOTES.

HARVARD ENGINEERING DINNER.—Harvard men interested in engineering will meet at a dinner at the Broadway Central Hotel, New York, Saturday evening, February 16. Prof. I. N. Hollis and other members of the faculty will be present.

A. S. I. R. A.—The headquarters of the American Street and Interurban Railway Association have been removed from 60 Wall Street, New York, to the new Engineering Societies Building, where the association has a very handsome and commodious suite of offices. As an affiliated society it will be one of the largest tenants in the new building, which is now rapidly filling up, with the offices of different bodies.

NEW YORK FRANCHISES.—A bill affecting the New York State Commission of Gas and Electricity has been introduced in the Assembly. It prohibits a city from granting a franchise for lighting, heating and power without certification of its necessity from the commission. The commission may inquire as to the necessity of the service and as to the intentions, ability, and good faith of the applicant, and if satisfied that the territory within which such franchise is to operate is already adequately supplied, it may refuse to grant a certificate.

HIGH VOLTAGES.—The New York Electrical Society will inaugurate its regular meetings in the new Engineering Societies' Building, where it now has its home, with a lecture on February 27 by Prof. Harold B. Smith, M.E., of the Worcester Polytechnic Institute, on "Power Transmission Voltages of To-Day and To-Morrow." This will be illustrated by lantern slides. Prof. Smith has done some of the most interesting and advanced work in this direction, and the society could hardly have chosen a better topic for this first function in the Engineering Building.

ELECTRIC VEHICLES AND SNOW STORMS.—The recent heavy snow fall has demonstrated the value of auto-trucks over horses for delivery service about the streets of this city. The head of one of the largest breweries in New York is authority for the statement that five large electric trucks he employs have performed the same work done last winter by eight wagons and thirty-two Percheron horses. The cost of maintaining a large stable is much greater than that entailed by the use of motor wagons. This man says the big autos literally "eat up the snow."

LIGHTING RAILROAD CARS.—In order to lessen the chances of such havoc and loss of life as occurred in the disastrous wreck on the Pennsylvania Railroad at Lochiel in May, 1905, a bill has been introduced in the Pennsylvania House by Mr. Esler, of Allegheny. It provides that, beginning June 30 of this year, it shall be unlawful for any sleeping cars on the railroads in this State to be lighted with anything other than electricity, the companies operating the cars to be held responsible. Any company operating such cars without furnishing such lighting after the date named will be guilty of a misdemeanor and conviction will subject the company to a fine of from $100 to $1,000 for the first offence for each and every car so operated and for each succeeding offence the fine shall be from $500 to $5,000 for each car.

TELEGRAPH OPERATORS appear to be in a restless and dissatisfied mood all over the country. The Postal Company has recently had a good deal of trouble with its men and now difficulties are reported in the Western Union system. A general movement is on foot among the telegraphers of both the large telegraph companies for an increase in wages. At a recent meeting over 400 Western Union telegraphers joined the Chicago local of the Commercial Telegraphers' Union in a body. A committee from their number was selected to come to New York to confer with the officials of the Western Union in this city in regard to a petition presented to the Chicago management. A committee of the Postal's telegraphers of this city is now carrying on negotiations with the officials of that company. Action of the same kind has been taken at New Orleans, Savannah, Birmingham, San Antonio, Houston and many other cities.

A CHEMISTS' BUILDING.—A plan is on foot and has been reported to the Chemists' Club of New York City to organize a stock company whose directors would have exclusive control of the building after erection and should enter into a lease on very reasonable terms with the Chemists' Club for such space as it may require for meeting room, library and social purposes. The Chemists' Club shall have the right to sublet the meeting room under similar conditions, as they sublet rooms now at 108 West Fifty-fifth Street, and suitable restrictions should be placed upon the Chemists' Club so that only scientific, musical and kindred societies may become subtenants. It is proposed to give the building ten laboratories for chemists and from ten to fifteen sleeping apartments. There will also be the Parkin Library, baths, bowling alley and a small gymnasium, as well as a hall capable of seating 500 people. At present it is intended to put up this building in Fifty-ninth Street, near Central Park.

ADIRONDACK POWER.—Considerable discussion and some opposition is developing in regard to the proposed amendment to the New York state constitution, so as to allow private corporations to flood state lands through the building of storage dams.

UNDERWRITERS' MEETING.—The general annual meeting of the electrical committee of the Underwriters' National Electric Association will be held at the rooms of the New York Board, 32 Nassau Street, March 27 and 28, at 10 a. m., when the National Code will be taken up. The presence and participation of all interested in the installation of wires and apparatus is invited.

WIRELESS IN GREECE.—The U. S. Department of Commerce and Labor states that Greece was represented at the wireless telegraphy convention that met recently in Berlin. As a result, the minister of marine has ordered that the trees of the battleships be rigged out with the necessary appliances for wireless messages. The central station of wireless telegraphy on the Island of St. George is nearly completed, and in a short time German experts will be sent for to make the installation.

BOSTON WIRE BILL.—It is stated that Mayor Fitzgerald, of Boston, Mass., has been convinced by the arguments of the insurance companies against his plan for legislation to compel them to pay the expenses of the municipal wire department of Boston, and has offered to withdraw his bill. His decision to withdraw was announced to the legislative committee on insurance last week when the subject was called for a public hearing. The hearing was closed, and the leave to withdraw will be reported by the committee.

ELECTRIFYING THE PENNSYLVANIA.—The following item from Philadelphia is interesting but not particularly new: "The Pennsylvania Railroad Company has under consideration a plan to substitute electricity for steam in its suburban surface and feeding lines. Whether the plan will be adopted will depend upon the report of a commission which recently returned from Europe, of which Charles M. Schaeffer, superintendent of passenger transportation, is chairman. This commission went abroad to study the working of electricity on railroads, and it is understood considerable information in favor of such power within city limits and on short runs was brought back."

THIRTY-TWO MILLIONS is the sum given last week by Mr. John D. Rockefeller to the General Education Board, for its work in behalf of educational interests. While there is no provision accompanying the gift that any of the income shall not go to any universities, it is the purpose of the board to assist colleges, as distinguished from the large educational institutions. Hence it appears that Mr. Rockefeller in turning over the $32,000,000 to the board does not necessarily relinquish his special and personal interest in the University of Chicago, the big institution which he founded and to which he has given $21,416,921. Even without including that amount, the present gift is the largest sum ever contributed by any individual to any social or philanthropic purpose.

CONNECTICUT CORPORATIONS.—Governor Woodruff, in a special message to the Connecticut Legislature last week attacked the public service corporations and declared himself in favor of extending the power to the railroad commissioners to hold a tight check rein over these corporations, alleging that their securities held too much water, and the harm already caused by their methods and financial deals makes legislative action imperative. The effect, he says, is to cause a drain on the public purse, by daily imposition of higher rates for service and fares than would be demanded to net a fair dividend, were there less liquid and more substance in the stock of such corporations." It is therefore high time, the governor declares, that the general assembly take under consideration the enactment of legislation that will prevent a repetition of this practice.

CHICAGO OWNERSHIP.—The following interesting item comes from Springfield, Ill., under date of February 7: "Municipal ownership for Chicago is booked for a death blow when the new charter for that city reaches the Legislature. That is now expected to be next week or the week after. The house intends to do one good thing to the new charter, and it will do that thing good and proper," declared one of the leaders of the majority. "We don't intend to raise the debt-borrowing power of Chicago $75,000,000 or $100,000,000, and then place that huge amount of the taxpayers' money at the disposal of any of the municipal ownership leaders, who may at any freak election in the future manage to get control of the city government or board of aldermen in Chicago. We intend to change the public indebtedness section of the charter so that under no excuse can the city's borrowing power, as increased by the new charter, be sunk in any ownership speculations or public utilities."

PEPCO NEWS is the title of a new central station bulletin, of which two numbers have now been issued by the Potomac Electric Power Company, of Washington, D. C. It is of large standard octavo size, 9¾ by 6¼ in., 16 pages, and is printed in colors with black type text. The bulletin as a means of central station or sale-of-current propaganda will long remain one of the best mediums for interesting the public, and this is certainly one of the best publications of the kind, free from slang and vulgarity, direct in its appeal, well argued, and convincing in its facts. Incidentally the bulletin contains a good deal of technical data relative to electrical development in the District of Columbia, one article dealing briefly with the new Bennings steam power plant of the company, to have a capacity of 30,000 horse-power in Curtis turbo-generator units, with coal-storage of 100,000 tons. The Bates advertising agency, through Mr. Converse D. Marsh, is responsible for this addition to our useful contemporaries of the central station class—the "mosquito fleet" of electrical development.

EMPIRE STATE ASSOCIATION.—Secretary Chapin, of the Empire State Gas and Electric Association makes some interesting remarks in his report for January. He says: "The publicity work which has been undertaken has progressed very satisfactorily during the month of January, articles having appeared in both New York City and out of town papers. A map showing the location in which these articles have been published indicates that matter favorable to the lighting industries has appeared very generally throughout the State and has necessarily reached a large number of people. The map also shows that the work is not restricted to any one or two communities, but is general and therefore is of benefit to all the members irrespective of where they are located. In connection with this publicity work, we subscribed to something over one hundred newspapers from all parts of the State which are carefully read and from which are clipped not only items of local or general interest pertaining to the business but also all advertisements for gas and electricity. It is surprising how little of this newspaper advertising is done by the lighting companies and also how many companies will continue the same "ad." long after it has lost its novelty and therefore its best effect in attracting attention. Frequent changes do not add greatly to the expense but do add enormously to the results obtained. A complete file of such advertisements, as are found, is being kept and should, I think, be very useful to any member who can find time to stop in this office when he is in New York. Some of the "ads." are extremely clever and an inspection of this file would, doubtless, result in many new ideas."

A LIGHTING DISPUTE.—Controversy has arisen between Colorado Springs and the Pike's Peak Hydro-Electric Company as to an alleged overcharge for street arc lights. The three arbitrators are Messrs. L. G. Carpenter, H. Floy and E. L. Elliott. Among the experts to testify are Messrs. L. B. Marks, W. D'A. Ryan, Dr. Louis Bell, Prof. Matthews, of Purdue University, and Prof. Shedd, of the University of Colorado. The amount involved is about $17,000, and the dispute hinges on the definition of a 2,000-cp arc light.

ENGLISH ELECTRICAL COMPETITION.—It is stated in a government report that representatives of several firms in the electrical industries in England held meetings recently to consider the forming of a combination or agreement through which the present sharp competition may be abated. It is claimed that between foreign dumping and competition generally, and the competition among British companies themselves, net profits are impossible without reducing costs at the expense of efficiency. No definite conclusions has yet been reached in the matter.

LORD AVEBURY'S VIEWS on the subject of municipal ownership are well known. He has just issued a small volume on the subject, giving these conclusions: The undertaking by municipalities of commercial undertakings is undesirable mainly on five grounds: First, the legitimate functions and duties of our municipalities are already enough, if not, indeed, more than enough, to tax all their energies and fill up all their time. Secondly, it has involved and will involve an immense increase in municipal debt. Thirdly, it will involve municipalities in labor disputes. Fourthly, as there will not be the same stimulus to economy and attention, there will be a great probability, not to say certainty, that one of two things will happen—either there will be a loss or the service will cost more. The working classes will, of course, be the greatest sufferers. Fifthly, it is a serious check to progress and discovery.

BROOKLYN TRANSPORTATION.—In a speech last week to allied civic associations President Winter, of the Brooklyn Rapid Transit system made some interesting remarks. He said that public sentiment was the hardest problem he had to face when he came to the Brooklyn Rapid Transit. He told how $25,000,000 had been put into improvements in the last two years and said the time had come for expansion by extensions and new lines, but the franchise problem confronted them. He said the Brooklyn Rapid Transit was paying for its franchises $3,000 a day in taxes and $350,000 a year to the city for carrying passengers over the bridge for nothing. In seven years the bridge elevated trains had cost $1,957,000 more than the receipts, and in 1906 the deficit in this item was $287,000. That they should pay for the privilege of carrying the people over the bridge for nothing was preposterous. He said he had recommended an elevated loop to connect the two bridges, the only relief in his opinion. Next would be proper terminals.

GIFT TO RENSSELAER.—President P. C. Ricketts, of the Rensselaer Polytechnic Institute, of Troy, N. Y., announces a gift of $1,000,000 from Mrs. Russell Sage for the creation of the Russell Sage School of Mechanical and Electrical Engineering. In her letter of gift Mrs. Sage says: "I write this letter so as to make my gift, to which I attach no conditions, a personal obligation upon me, and in the event of my death before consummating it, upon my estate. It is right that you should have such a letter before you should begin to make your plans. I am quite willing that this gift should be announced pursuant to your desire at the meeting of your trustees and of your alumni to be held as I understand some ten days hence, and to leave the form of announcement to you, except that in making the announcement I should like to have the fact of my own and Mr. Sage's previous relations to and interest in the Polytechnic made apparent, as a reason for the gift and as differentiating the Polytechnic from other institutions who have made applications to which I have not responded, and with which neither Mr. Sage nor myself had any personal official relations."

A CHALLENGE TO CRITICISM.—The Municipal Voters' League, of Chicago, in a recent report, made some very strong, but loose, assertions about the ordinances of the Chicago Edison and Commonwealth Electric Companies. Mr. W. G. Beale, counsel for the companies, has publicly challenged the report, and offered to pay all expenses of an investigation by five disinterested leading citizens. He says: "Let me say that the gentlemen in charge of the affairs of the Chicago Edison Company and of the Commonwealth Electric Company are just as much interested in the welfare of this city—and possibly just as regardful of it—as the members of the executive committee of the Municipal Voters' League. They have a right to resent, as I have a right to resent, the imputation that we were seeking from the City Council an ordinance manifestly bad and improper. There is more at issue than merely the quality of a dead ordinance, which, as a matter of fact, was not sought by the lighting companies at all. Neither the Edison Company nor the Commonwealth Company sought the passage of any ordinance or has desired the passage of any, and neither of them wishes or needs any ordinance now. The alleged defects in their existing ordinances are mostly trivial and none are troublesome."

ALASKA TELEPHONE SYSTEM.—The system of the Alaska Telephone & Telegraph Company, of Seward Peninsula, Alaska, has been extended to a degree little appreciated by the Eastern public. Over 1,000 miles of wire is now in operation between the various camps of that region. The line from Nome to Tin City is the longest wire that the company is operating, being 157 miles long. It is the only line in Alaska in which a submarine cable carries the messages for a part of the distance. This cable is under Grantley harbor, near Teller. To guard against accident the aerial wire is also strung at a great height, the poles on either side being 120 ft. high. The second longest line is to Candle Creek, a distance of 138 miles, from Council, the course carrying it through the Council district. There are two lines to Kougarok, one of 122 miles and the other of 130 miles. A wide expanse of barren, uninhabited country is covered by the Candle line, which was the cause of much hardship and heavy cost at the time of construction. The main exchange is at Nome, where there are two local switchboards and one long-distance board. There are 130 camps and roadhouses provided with telephones, in addition to numerous business houses and cabins situated within the "city limits" of the larger camps.

WASHINGTON PUBLIC UTILITIES.—Representative Morrell, of Pennsylvania, a member of the House district committee, introduced a resolution authorizing the appointment of a commission to collate information and consider and recommend legislation concerning the public utilities in the District of Columbia. The bill provides that a commission shall be created to be called the public utility commission, to be composed of three members of the House, to be appointed by the Speaker, two members of the Senate, to be appointed by the presiding officer in charge. It shall be the duty of this commission to investigate questions appertaining to the lighting of the District, gas and electric; telephone system; operation of street railways and any other utility which, in their judgment, requires investigation, and to report to the next Congress and suggest legislation as it may be best on these subjects. The commission shall give reasonable time for hearings if it deems necessary, and it shall be allowed all necessary expenses. It shall have authority to send for persons and papers and to administer oaths and affirmations. Necessary expenses to the amount of $25,000 are provided for, to be payable out of the treasury of the United States. Vacancies occurring in the commission shall be filled by appointment by the speaker and the vice-president.

Electric Generating Station of the Paxtang Electric Company of Harrisburg, Pa.

THE power plant of the Paxtang Electric Company is located at Cedar and Commerce Streets, about 100 ft. from the Pennsylvania right-of-way on the right bank of Spring Creek at the southern boundary line of the city of Harrisburg, Pa. This location is about 500 ft. from the Susquehanna River and between the Pennsylvania and the Philadelphia & Reading Railroads over both of which coal can be obtained, making an ideal selection for low cost generation. The entire station output is transmitted to a sub-station on State Street in the center of the city and about 3 miles from the power house.

The superstructure is a steel skeleton frame with monitors, the walls being of brick and the entire building presenting typical mill type construction. The dynamo room floor is designed for a gross load of 400 lbs. per square foot and is made up of a steel frame of I-beams between which concrete arches are sprung to an elevation corresponding to the top of the I-beam flanges. Over this filling a 3-in. granolithic floor is laid in panels, each panel being laid separately in order to provide for expansion and contraction. The boiler room floor is laid on top of a slag and cinder filling and is about 6 in. thick with a 1-in. cement finish.

The boiler room is arranged for the installation of four batteries of water-tube boilers. Two batteries of 300-hp B. & W. boilers are arranged on one side of the stack and on the other side there is being installed a battery of 500-hp Campbell & Zell boilers, the stack having openings on opposite sides for connecting the breeching. Each of the B. & W. boilers is composed of 16 headers 9 high and two steam and water drums 42 ins. in diameter by 23 ft. 5 ins. long carried on the usual B. & W. steel frame suspensions, but set one foot higher than standard in case stokers should be installed at some future time. The boilers are designed for a steam pressure of 160 lbs., and are of the cast iron header type of construction. The furnaces are arranged for hand firing, the grates being provided for burning a mixture of soft and river coal. The settings are laid up in lime cement mortar with common brick, the corners being round-nose brick. The fire brick for the furnaces are laid up in fire clay. Fig. 6 shows a view of the boilers now in operation.

Each boiler is provided with a steel up-take designed to saddle the drums at the rear directly on top of the boiler. The main breeching, which rests directly on top of these up-takes, is built with circular tube of 3/16-in. plate throughout, reinforced and stiffened with angle and tee bars. Each up-take is provided with an individual damper and a main damper is installed in the breeching near the stack. Each individual damper is controlled by the main damper regulator which operates a lay shaft to which each damper may be connected or disconnected at will.

The stack is 9 ft. inside diameter by 175 ft. high, constructed of molded perforated radial brick of the Custodis type. Two clean-out doors are provided in the fire-brick lined pedestal which is 32 ft. high and octagonal in shape. The shaft itself is unlined. The stack is designed to produce draft for 2,400 boiler horse-power.

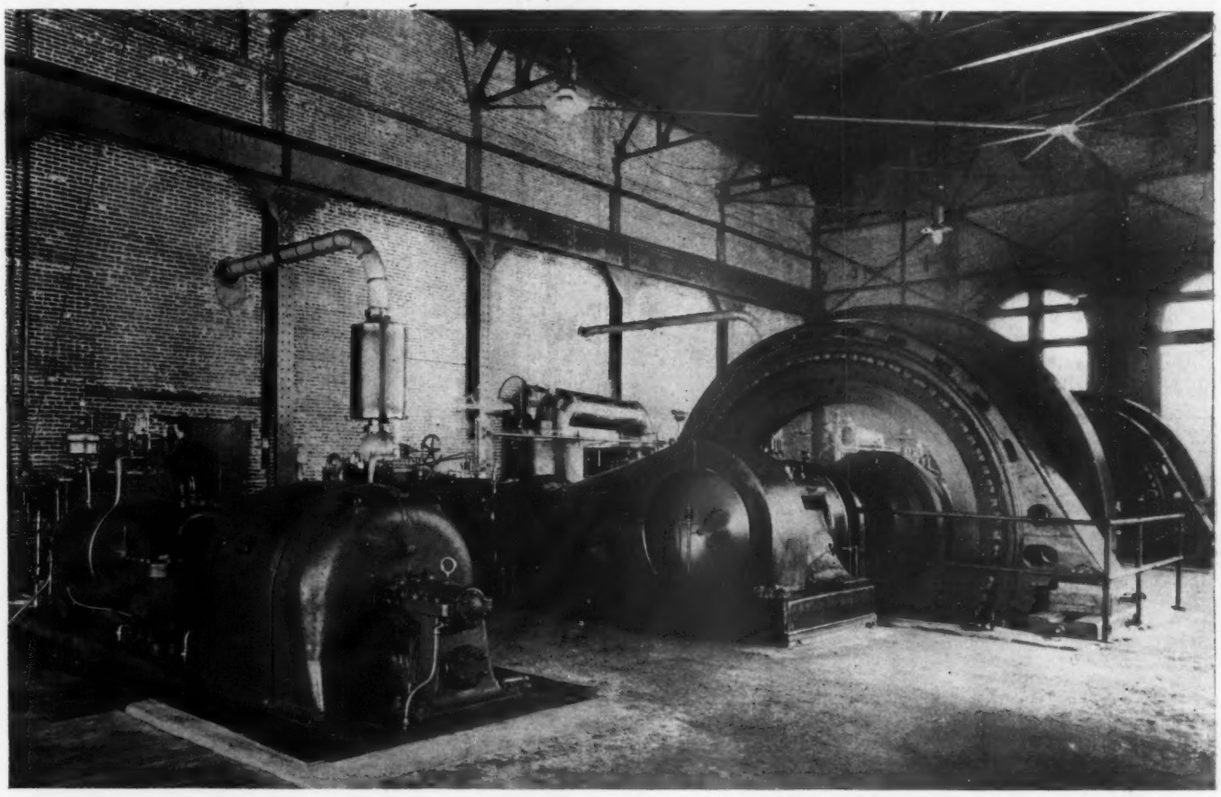


FIG. 1.—GENERAL VIEW OF STATION, SHOWING TURBINE IN FOREGROUND.

The steel work in the boiler room is arranged for an overhead coal bunker having a capacity of about 5 tons per running foot. It also provides for the installation of coal and ash handling machinery when desired. The conveyor will loop through a trench under the boiler room floor up at the ends and through the trusses in one continuous line, in order that coal may be received by a receiving hopper at both ends and also that ashes may be discharged at either end of the boiler house. At present the coal and ashes are taken to and from the boilers in barrows.

The dynamo room equipment includes one 300 and one 500-kw direct-connected set, and there is now being installed a 500-kw Westinghouse turbo-generator. Each engine is of the cross-compound, condensing Corliss type built by the Fulton Iron

Works, of St. Louis, Mo. The larger unit operates at 100 r.p.m., the smaller at 120, each engine giving its rated output at 150 pounds steam pressure and ⅛ cut-off. A feature of the engine equipment is that the engine frames are of the heavy-duty, 1890 Reynolds-Corliss pattern. Engines of this type are rarely found outside of rolling mills where the heaviest duty is required. The engines are of standard construction and each is equipped with a motor attachment for synchronizing. There are two Harrisburg "Standard" automatic engines direct-connected to two exciter generators, developing 34 hp on 150 lbs. steam pressure. These exciter units are shown in Fig. 3.

The plant is equipped with a barometric elevated jet condenser having a capacity for condensing 75,000 lbs. of steam per hour. This condenser is of the Worthington dry vacuum type, the cone being fitted with a cooler from which the circulating water passes on its way to the condenser. The condenser is supported 34 ft. above the hot well water level by means of a tail pipe from which the overflow runs to the hot well. The location of this condenser is shown in the plan view of the power house and also in Fig. 2. The plant is equipped with one 10-in. by 18-in. by 18-in. rotative dry vacuum pump having ample capacity for removing all the air from the condenser cone when worked to its full capacity. The circulating water is supplied by a 10-in. two-stage centrifugal pump direct-connected to a 9-in. by 12-in. vertical engine. This pump is located in the dry well beneath the engine room floor and takes water from the Susquehanna River under 18-ft. suction lift in case of extreme low water, and discharges to the condenser cone 50 ft. 4 in. when unassisted by vacuum in starting up. This head is, of course, decreased afterwards to the extent of the vacuum carried. The speed of this circulating pump is variable, starting at 325 r.p.m. and decreasing to 235 r.p.m. under normal conditions.

The boiler feed-water pumps are two in number and are of the horizontal simplex type built for heavy duty. There is a 1,200-hp Cochrane feed-water heater and purifier provided into which all the auxiliary steam of the plant is exhausted. The

FIG. 2.—VIEW OF EXTERIOR OF POWER HOUSE.

dynamo room is provided with a 20-ton overhead traveling crane of the hand power type. The crane is mounted on a runway with a 54-ft. span. It is operated from the engine room floor in the usual manner by chains.

The boilers are piped to a main steam header and each boiler lead is composed of an agle globe valve and a long return bend and angle gate valve mounted directly on the header which is made up of 12-in. wrought-iron pipe with cast-iron screw flanges, flanged valves and fittings. The engine leads are composed of long radius bends made up with heavy flanges. The auxiliary piping is connected with the main header and is carried to a sub-header under the engine room floor to which the various auxiliaries of the plant are connected. All high pressure steam piping is made up with extra heavy cast iron flanged fittings for all sizes over 2½ ins. and extra heavy Chapman valves. All high pressure steam lines are of full weight standard lap welded pipe, the gaskets being of corrugated copper.

The main exhaust pipe is composed of two main engine branches and a main exhaust header into which they connect and run to the central condenser. The branches are of cast iron and the main exhaust piping is made up of ⅜-in. steel plate with cast-iron riveted flanges. This main exhaust piping

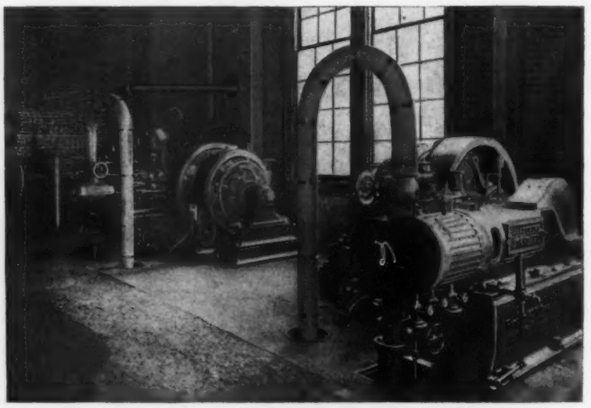


FIG. 3.—VIEW OF EXCITER SETS.

is operated under vacuum conditions and has proved to be absolutely tight. The joints are made up with ⅞-in. rivets, 2-in. pitch and sheets caulked inside and out. The auxiliary exhaust piping is connected to each steam auxiliary and conducts the exhaust either into the open heater or to the open air. It is also piped so that it can be discharged into the receivers of the main engine enabling the engineer to utilize practically all the exhaust steam of the plant.

The condensing water is obtained from a crib located about 100 ft. from the east bank of the river by means of a gravity line 30 in. in diameter supplying an intake well near the building. Suction lines connect this well with the circulating pump. The discharge line from the circulating pump to the condenser is provided with a branch to the feed-water heater so that under ordinary working conditions the circulating pump supplies the feed-water heater and permits the feed pumps to be operated as hot water pumps. The feed pumps also have an independent suction line from the intake well so that in case the circulating pump is shut down, feed water may be taken direct from the river and discharged through the heater by one pump and to the boilers by a second pump. The feed-water pump discharge piping is designed for high pressure and run with a single header and branches to each of the boilers. The boilers are also equipped for using city water supplied through injectors on each boiler, giving ample provision for boiler water supply.

All high pressure drips are drained to the boilers by the Holly gravity return system. All drain points are gravitated to the receiver and each drip line is connected to a header and by-passed to a low pressure header so that should it become necessary to cut out any drip line from the Holly system it can be done by simply opening and closing two valves. The connection from the discharge chamber to the boilers is by means of a header with a branch to one of the drums of each boiler, thus providing for a connection to each boiler so that the drains may be taken care of in the operating boiler.

The plant is equipped with a gravity engine oiling system composed of an oiling table on which are mounted two duplex pumps, a receiving tank in the basement for receiving new oil and that drained from the filter, and a gravity tank located between the roof trusses into which tank the pumps discharge. This provides the necessary head for feeding the oil to the engine bearings. All the oil used in operating the main engines is collected or piped into the crank pits which are of the en-

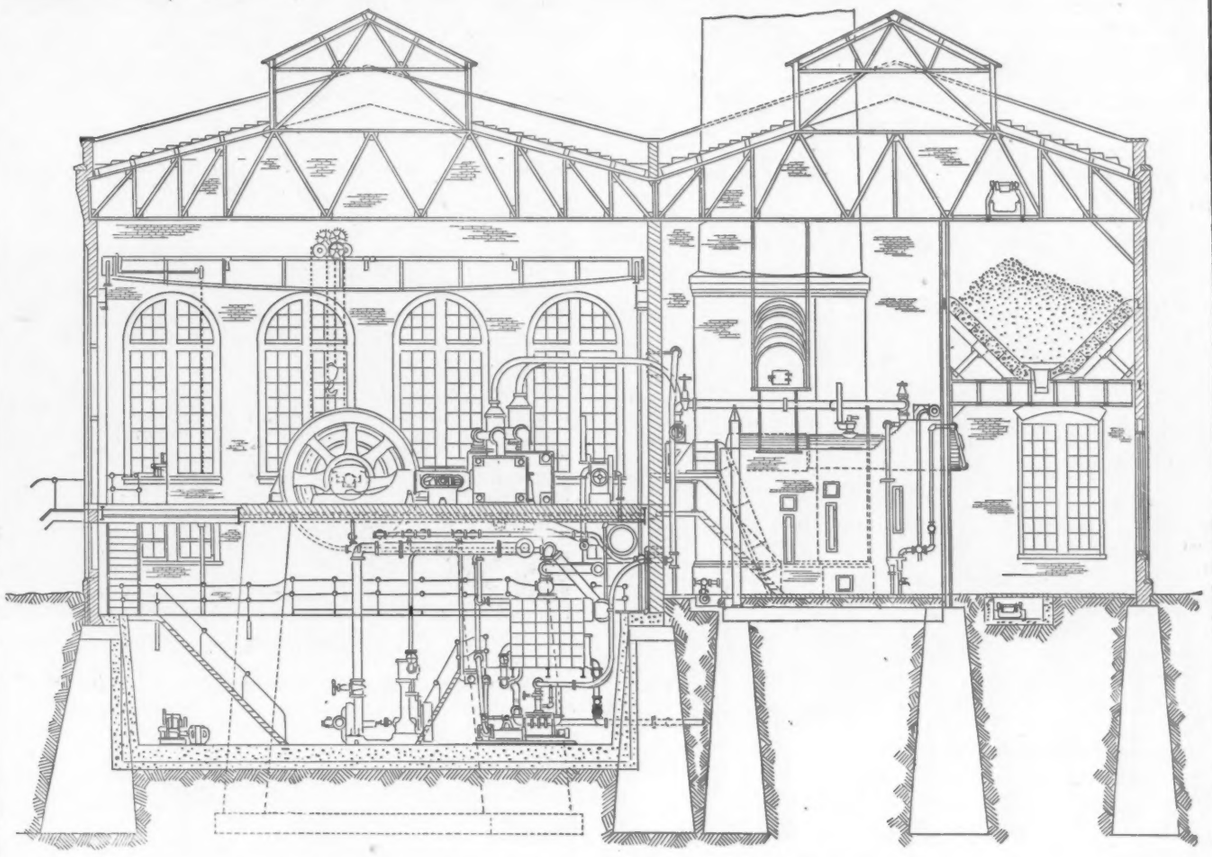


FIG. 4.—CROSS-SECTION OF POWER HOUSE, PAXTANG ELECTRIC CO.

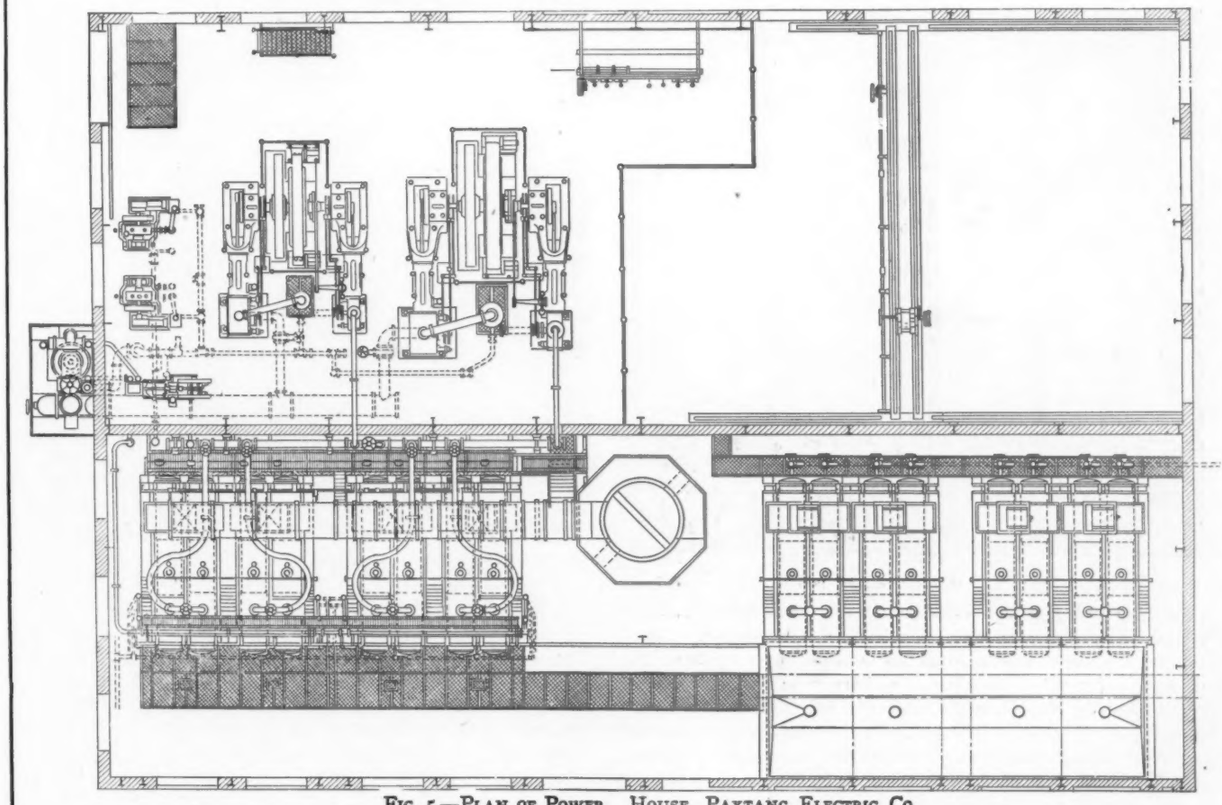


FIG. 5.—PLAN OF POWER HOUSE, PAXTANG ELECTRIC CO.

GENERATING STATION OF THE PAXTANG ELECTRIC COMPANY, HARRISBURG, PA.

closed pattern. From these points the oil is piped to a drip header and discharges into the filter. This allows of a complete cycle of circulation of the oil with little loss.

The boiler blow-off piping is made up of a Morris angle blow-off valve and a special tee branch which is capped and provided with swing bolts. Each boiler blow-off branch is connected to a 3-in. header which is piped to the creek outside of the boiler room. The blow-off pipe is carried in a trench back of the boilers.

The generators are of the Westinghouse revolving field type, delivering two-phase, 3,500-volt, 60-cycle current. The machines have a regulation of 6 per cent on unity power factor and have a high efficiency. The new turbo-generator is also of Westinghouse make and delivers current at the same frequency, phase and potential as the other units. The two exciter generators are of standard construction, being 35-kw, 125-volt machines. These are compound wound for a two per cent rise in pressure between no load and full load, so that allowing for losses in the exciter leads and switchboard connections they give a practically constant pressure irrespective of the current required by the generators, and do not require adjustment of their rheostats for maintaining the exciter bus pressure. The efficiency of the exciters at full load is 91 per cent and either one has sufficient capacity to excite both units at full load.

The switchboard installed in the power house was furnished by the Westinghouse Electric & Manufacturing Company, and a view of the board is given in Fig. 7. All the indicating instruments on the board are supplied with current from constant potential and constant-current transformers so that none of the instruments has a tension of over 200 volts. The switches, which are of the non-automatic oil type, are mounted on an iron framework midway between the panels and the wall and are operated by levers. Duplicate bus-bars are installed on the board and oil switches are arranged so that the busses may be joined together when necessary. The field rheostats are suspended from the floor girders and connected to hand wheels on the panels by means of chains and sprockets. The board comprises one swinging voltmeter panel; two exciter panels, three generator panels, one station panel and one line panel.

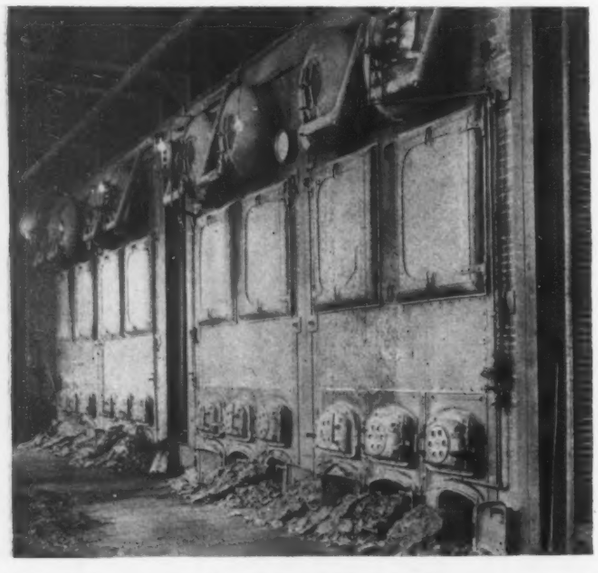


FIG. 6.—VIEW OF BOILER ROOM.

The swinging voltmeter panel has mounted upon it three alternating-current voltmeters, one of which can be plugged to either phase of either generator, the other two being permanently connected, one to each set of bus-bars. A synchroscope is also mounted on this panel and arranged to plug to any generator and either set of bus-bars. There is a synchronizing lamp mounted over this instrument and another lamp on each generator panel. These operate in conjunction with the synchroscope. There is also two 6-point receptacles which are used with the synchroscope. The exciter panels have an ammeter, voltmeter, rheostat hand wheel, voltmeter switch receptacle and triple-pole single-throw knife switch.

Each of the generator panels has two indicating wattmeters, two ammeters, generator field rheostat hand wheel, voltmeter switch receptacles, synchronizing receptacles, field switch and lever for operating a four-pole double-throw oil switch mounted back of the panel. The polyphase watt-hour meter is mounted on the sub-base and connected to read the output of the generator. The station panel has mounted upon it two levers for controlling two double-pole, single-throw oil switches used to connect two sets of bus-bars in parallel. The line panel is equipped with two ammeters and two double-pole double-throw oil switch levers.

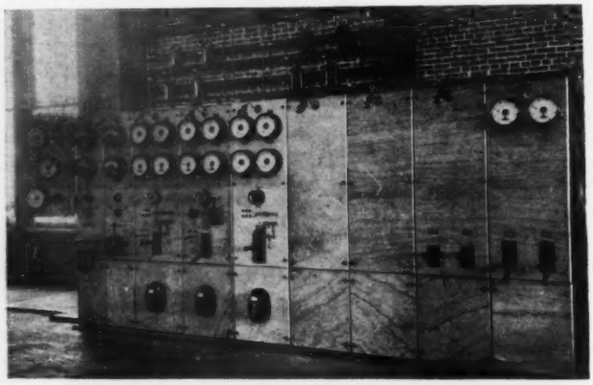


FIG. 7.—SWITCHBOARD.

For the protection of the machinery in the power house there have been installed lighting arresters of the low-equivalent type with choke coils, spark gaps, low resistances, etc. These are placed at the ends of the transmission lines at the point where they enter the building. The overhead lines throughout the transmission district and the distribution district are protected by arresters installed every 1,200 ft.

The transmission lines consist of two two-phase lines of No. 0 B. & S. weather-proof copper wire which extend from the power house to the sub-station. The transmission lines are carried both overhead and underground; on poles through the country from the plant to the more thickly built up part of the city, and from there on in underground conduit to the sub-station on State Street. Both the pole line and subway have provision for an additional circuit. The cable in the main transmission circuit underground is No. 0000 B. & S. gauge, four-conductor rubber-insulated, lead-covered and designed for a working tension of 5,000 volts.

The sub-station is located about two blocks from the Pennsylvania state capitol. It contains switchboards and regulating transformers for the distribution of 3,300-volt, two-phase current throughout the subways and pole lines in the city of Harrisburg. There is also located here a 300-kw motor-generator set for furnishing direct-current for motor service which installation was demanded on account of the large number of direct-current motors in use in the city. This motor-generator set, which is shown in Fig. 8, consists of a 300-kw, compound-wound, direct-current generator compounded from 254 volts at no load to 280 volts at full load; the motor is a 3,300-volt synchronous machine, to which is belted a 15-kw, 125-volt, compound-wound exciter. The set is started by means of a 400-volt induction motor mounted on the end of the shaft.

The sub-station switchboard, a view of which is given in Fig. 9, is made up of one line panel, one double-circuit alternating-current feeder panel, one synchronous motor panel, one direct-current generator panel and one double-circuit direct-current feeder panel. Mounted on the line panel are levers for controlling two double-pole, double-throw oil switches. The alternating-current feeder panel has mounted upon it two ammeters, two single-phase watt-hour meters and levers for controlling two double-pole, double-throw oil switches. Upon the sub-base of the panel and the one adjoining it are mounted heads for controlling two feeder potential regulators, each cap-

able of increasing the tension of the circuits to which they are connected 10 per cent from 3,300 volts. The system of distribution is known as the loop system, each phase being kept distinct. The synchronous motor panel has mounted upon it the necessary instruments and switches. The direct-current feeder panel is arranged for two circuits on which the load is about equally divided.

From the sub-station a conduit system containing approximately 150,000 duct feet runs through the business section and the best residential section of the city. Single-duct, terra cotta conduit is used, the combination of ducts ranging from 6 to 25. Manholes are installed in every street in this section, and in many cases two distribution boxes are placed between adjacent manholes. In the construction of the subway system some difficulty was experienced by reason of the obstacles encountered. It was necessary to shift abruptly from one side of the street to the other, and a change of grade from 4 to 6 ft. was not unusual.

The high-tension and low-tension cables used in the subway system are rubber-covered and leaded, and with the exception of the single-conductor used for direct-current motor work, is two-conductor, with the addition of a four-conductor cable in the transmission line previously mentioned. On the more important streets both phases of alternating current are run and where the demand for motor service does not exist one phase only is installed. Motors up to 5-hp in capacity are connected to a single phase, while all others above this capacity are connected to both phases. In order not to affect the regulation, lamps and motors are fed from separate transformers.

The system is quite simple and flexible, much more so than the ordinary four-wire, three-phase installation, and by the use

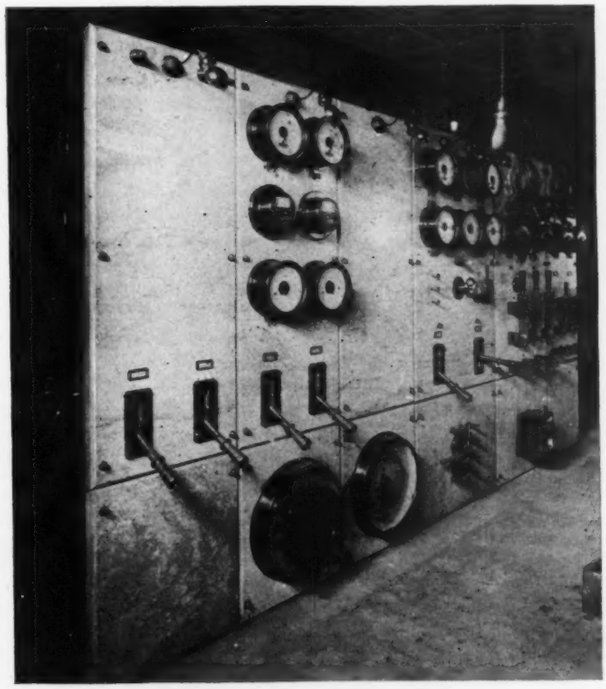


FIG. 8.—SWITCHBOARD IN SUB-STATION.

of 3,300 volts the copper economy is quite an important item when taken into consideration with the copper cost for a 2,200-volt system. At various points in the subway the high tension distributing cable is sectionalized by means of double-pole, water-proof oil switches. This enables certain sections of the high tension cables to be cut out for the purpose of repair or for the installation of transformers without in any way interfering with the service over the balance of the line. The overhead lines can also be cut off from the underground cables at will. This obviates the more familiar method of fuse installation on the poles.

The outlying sections of the city are reached by about 8 miles of pole lines, the circuits on these poles being connected to the high tension cable in the subway. The circuits throughout the pole lines are carried above all other wires of whatsoever description, thus reducing to a minimum the danger of short-circuits from broken telephone and telegraph wires. Provision is made on the poles for carrying secondary distribution circuits which are installed from time to time as the business in-

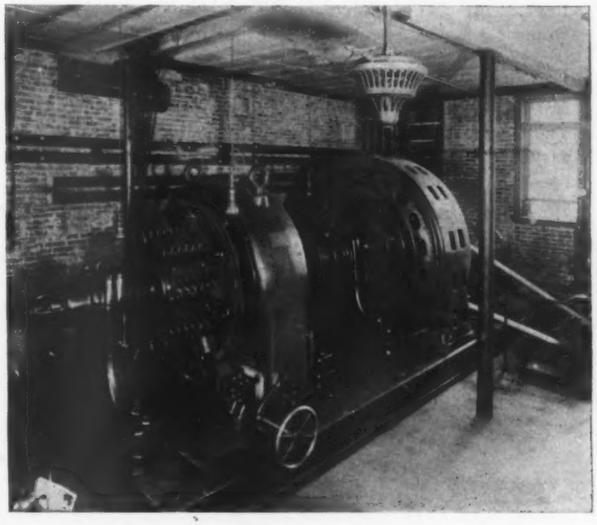


FIG. 9.—MOTOR-GENERATOR SET IN SUB-STATION.

creases. Where the demand for electricity is large, large transformers are used as distributing centers. By this means transformer losses are materially reduced.

The installation includes pole and subway type transformers wound for three-wire, single-phase secondary potentials of 220-110 volts. The sizes of transformers range from 1 to 15 kw for use on poles and from 10 to 40 kw for use in manholes. The secondaries throughout the conduit system are protected from transformer short-circuits by means of primary fuses placed in water-tight fuse boxes in each manhole. The entire system, which has now been in operation about four years, was designed and installed by the Western Electric Company, with whom was associated J. G. White & Company.

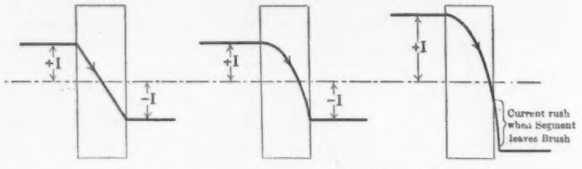
The rate for residential lighting is 9 cents per kw-hour; for commercial lighting it varies from 5 to 9 cents per kw-hour, and the rates for electricity supplied to motors range from 2 to 3 cents. At present the motor load approximates 300 kw. The company has installed over 3,300 Nernst lamp glowers to compete with gas arc lamps, and also with direct-current arc lamps. Two men devote all of their time to installing, repairing and maintaining the Nernst lamps. There are approximately 30,000 alternating-current incandescent lamps connected to the company's circuit.

The company supplies about 65 electric signs, some of which are connected on a flat rate, but none is put out on an installment basis. All lamps are renewed free of charge. The company does not at present employ any solicitors nor distribute any printed matter, although at one time there were three solicitors devoting their time to increasing the use of electricity. The company maintains a large electric sign outside its office on Market Street near the Square. By the terms of the franchise it is required to light 200 16-cp lamps in city buildings free of charge. Some wiring is done and a $15,000 stock of electrical supplies is kept on hand. The number of multiple arc lamps connected to the company's lines is about 300, divided almost equally between Western Electric, Adams-Bagnall and Jandus makes. Every man employed by the company, who is vitally connected with the operation of the system, is furnished with free telephone service. Mr. H. W. Hamblin is the manager of the company, to whom we are indebted for the information contained in this article.

Calculation of Dynamo Sparking Characteristics.

By Carlton L. Kennedy.

IN the ordinary direct-current armature, when the brushes are exactly on the neutral point, commutation of the current is effected entirely by the resistance of the brush contact. Were there no inductance in the coil undergoing commutation the rate of change of current in the coil during commutation would be a constant quantity and the ratio of the currents passing through the adjacent commutator segments connected to the coil would at any instant be equal to the ratio of the contact resistances between the bars and the brush spanning them. The current in the coil undergoing commutation would then vary according to Fig. 1, where the rectangle represents the brush face. The armature conductors, however, being placed upon an iron core do possess inductance. This inductance tends to retard any change in the current flowing through the short-circuited coil. The commutation diagram, therefore, assumes the form of Fig. 2. The current density at the trailing tip of the brush here becomes much greater than at the leading tip. The increased voltage drop due to this greater density of current at the trailing brush tip will still produce sparkless commutation, provided the product of current, inductance and rate of change of current is not excessive. When this product does become excessive, the condition of Fig. 3 results. Here



FIGS. 1, 2 AND 3.—COMMUTATION DIAGRAMS.

the rate of change of current at the last instant sets up a reactive voltage too great to be overcome by the voltage drop due to the contact resistance, and sparking ensues. Plainly, if one can calculate this reactive voltage, he has a measure of the sparking characteristics of the armature.

The reactive voltage of any electric circuit when the current in it is varied harmonically is:

$$V_r = 2\pi n L I. \qquad (1)$$

During the time in which the armature coil is undergoing commutation, the current change is that corresponding to one-half a complete cycle. If it is assumed that the width of the brush is the width of one commutator bar, then

$$n = \frac{c r}{2} \qquad (2)$$

when c is the number of commutator segments and r the number of revolutions per second.

The inductance of any electric circuit is

$$L = \frac{\Phi N}{I \times 10^8} \qquad (3)$$

In order to calculate the inductance of an armature coil it will be necessary to know the number of lines of force which will be set up around it, per ampere. Then, if l_1 is that part of the length of one turn which is embedded in the iron core, and l_2 is the part of one turn not embedded in the core, and if Φ_1 and Φ_2 are the number of lines set up per ampere-inch of l_1 and l_2, respectively, the total flux surrounding one turn will be

$$\Phi = I\ (l_1 \Phi_1 + l_2 \Phi_2) \qquad (4)$$

But with a full chord winding and armature conductors arranged in two layers, the top conductor of any coil undergoing commutation occupies the same slot as the bottom conductor of the coil undergoing commutation under the adjacent brush. Hence the total flux surrounding the "embedded" portion of any conductor is increased by that due to the other conductor in the same slot. The total flux surrounding one armature coil of N_1 turns is, therefore,

$$\Phi = N_1 I\ (2 l_1 \Phi_1 + l_2 \Phi_2). \qquad (5)$$

The entire volume of current which passes through any armature slot may be imagined to be concentrated in one conductor in the center of the slot, and all the lines of force set up by the current passing through it must surround this conductor. Their path, therefore, will lie in the iron surrounding the slot, in the non-magnetic medium in the upper half of the slot, and in the air surrounding the ends of the teeth. Since by far the largest reluctance in the path of these lines is where they pass through the non-magnetic medium, or air-gap, the permeance of their path will be approximately the permeance of this air-gap. To calculate this value it will be convenient to calculate separately the permeance of the path through the upper part of the slot, and that between the ends of the teeth.

In calculating the permeance of the upper part of the slot the length of the air-gap is obviously the width of the slot. The area of the air-gap, in square inches, for a section of the slot one inch long axially, is numerically equal to one-half its depth, since the flux must all surround the hypothetical conductor in the center of the slot. If d is the depth of the slot in inches and w its width, the permeance of the slot is $2.54 \frac{d}{2w}$. The number of lines set up in the slot per ampere inch of conductor will then be

$$.4\pi \times 2.54 \times \frac{d}{2w} = \frac{1.6\, d}{w} \qquad (6)$$

Fig. 4 represents a section through an armature slot and the adjacent teeth. Most of the lines which pass from the ends of

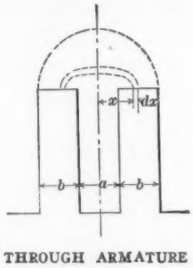


FIG. 4.—SECTION THROUGH ARMATURE SLOT AND TEETH.

the teeth will lie within the dotted semi-circle, whose radius is $b + a/2$. If dx represents the width at the end of a tooth of an elementary strip representing the path of any line of force, its average width will approximate $\frac{b + \frac{a}{2}}{b} dx$. Its length will be, nearly, $a + \pi\ (x - a/2)$, when x represents the variable distance of the strip from the center of the slot. The permeance of the path from the end of one armature tooth to the end of the adjoining one, when the length of the armature in inches is l will, therefore, be,

$$Permeance = \int_{a/2}^{b + a/2} \frac{2.54\, l\, (b + a/2)\, dx}{b\, [a + \pi\, (x - a/2)]}$$

$$= \frac{2.54\, l\, (2b + a)}{2\pi b} \log_e \frac{a + \pi b}{a} \qquad (7)$$

From this formula the lines set up from the end of the teeth per ampere-turn and per inch length of armature slot will be

found to be about 2.2 when $a = b$, and 2.7 when $3a = b$. A certain number of lines will be set up, however, which will seek other paths than that from the end of one tooth to the next. The total number set up which do not pass through the armature slot itself have been found by experiment to be about 4, instead of lying between 2.2 and 2.7. Hence, if Φ_1 represent the total number of lines set up per ampere-turn per inch of armature slot,

$$\Phi_1 = 4 + \frac{1.6\,d}{w} \qquad (8)$$

No simple method is available for calculating the lines set up per ampere-inch of the end connectors. The average of a number of experiments is that

$$\Phi_2 = 2 \qquad (9)$$

It will be sufficient to use this value, since the flux set up by the end connectors is so much the smallest part of the total flux that a certain amount of inaccuracy here will not greatly modify the final result.

Therefore,

$$\Phi = 2 N_1 I \left[\left(4 + \frac{1.6\,d}{w} \right) l_1 + l_2 \right] \qquad (10)$$

Substituting in the equation for inductance, (3),

$$L = \frac{2 N_1^2 \left[\left(4 + \frac{1.6\,d}{w} \right) l_1 + l_2 \right]}{10^8} \qquad (11)$$

Combining equations (1), (2) and (11) the expression for reactive voltage becomes

$$V_r = 2\pi n L I = \frac{6.3\,c\,r\,N_1^2 \left[\left(4 + \frac{1.6\,d}{w} \right) l_1 + l_2 \right] I}{10^8} \qquad (12)$$

This value is of course the effective voltage, provided the reversal of current in the commutated coil follows a sine curve. The actual curve followed at the last instant when near the sparking point is probably quite different, and very difficult to determine. For data which are to be comparative, however, it is sufficient to assume a sine curve, with the understanding that the reactive voltage as calculated is in reality not the actual reactive voltage, but that it furnishes a convenient means for determining the sparking characteristics of the armature.

Experiments have shown that with carbon brushes of average quality set on the neutral point, the sparking point is reached when the current has such a value that the reactive e.m.f. is about ten volts. Therefore, at the sparking point,

$$I = \frac{10}{\frac{6.3\,c\,r\,N_1^2 \left[\left(4 + \frac{1.6\,d}{w} \right) l_1 + l_2 \right] P_p}{10^8\,m}}. \qquad (13)$$

The factor m, which represents the number of circuits between which the current divides, is introduced to reduce the current output to current per circuit. The factor P_p, representing the number of pairs of poles when a two-circuit winding is used, is necessary, since in a two-circuit winding the number of coils in series and commutated under one brush is equal to the number of pairs of poles, when only two sets of brushes are used; when, however, as many sets of brushes are used as there are poles, the sparking will be considerably reduced. The amount of this reduction will depend upon the division of current between the different sets of brushes, and this in turn upon the differences in quality, pressure and wear of the brushes. When a multiple-unit winding is used, $P_p = 1$.

Equation (13) is approximately true, whether the brush covers one or more bars, since although the increasing of the arc of brush contact decreases the frequency of commutation, it also increases the number of coils being commutated at the same time, and hence increases the total change of magnetic flux surrounding the commutated coil. Of course not all of the lines of force reversed by several coils being commutated at once will pass through any one of the coils being commutated. This is practically compensated for, however, by the fact that the larger part of the reversal of the current is accomplished just before the commutator bar passes out from under the brush. The effective frequency is therefore not decreased in proportion to the number of commutator bars covered. The net result is a nearly constant reactive voltage with different thicknesses of brush. If, as is usually the case, the pitch of the winding is one tooth less than a full chord winding, the mutual inductance and hence the reactive voltage, will be somewhat decreased if the brush covers only one segment. This is because the top conductors of one coil will no longer lie in the same slot as the bottom conductors of the coil being commutated under the adjacent brush. If, however, the brush covers several segments, as is usual, then the mutual inductance is not very materially reduced by using a pitch one less than a full chord.

When a dynamo is in operation, however, it seldom happens that the brushes are upon the exact neutral point. It is, therefore, necessary that an expression for the sparking point should include the effects of field distortion, and allow for the initial lead given the brushes. In order to do this it will be necessary to calculate the voltage generated by the coils short-circuited during commutation, due to their cutting lines of force.

In any direct-current armature the voltage generated across any small section of the commutator may be calculated, provided the flux which is being cut at that instant by the coils connected to that section of the commutator, is known. The formula is of course:

$$E = \frac{\Phi\,N\,r\,P_p}{10^8}, \qquad (14)$$

where N and r are the total number of conductors on the armature surface and the revolutions per second, respectively, and Φ is the flux being cut. When the brushes are on the geometrical neutral point, any voltage generated by the short-circuited coils must be caused by a flux entering a section of the armature core which is f wide and midway between the pole pieces, f being the arc of brush contact. Since this section lies midway between the poles, the flux set up will be solely that due to the armature ampere-turns, and will be practically independent of the main field strength. The number of conductors concerned in setting up a flux in the region between any two pole pieces is of course twice the total number of conductors on the armature divided by the number of poles, or $\frac{2N}{P}$

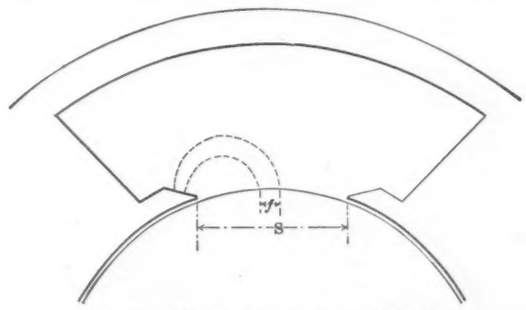


FIG. 5.—MAGNETIC CIRCUIT OF DYNAMO.

The number of complete turns on the armature is one-half the number of conductors, or $N/2$. The current per circuit is the total current output of the armature divided by the number of

circuits through which the current divides, or I/m. The total number of ampere-turns per pair of poles, is therefore,

$$\frac{2NI}{2P_m} = \frac{NI}{P_m}.$$

The permeance of the path followed by the lines set up by this flux is practically the permeance of their path through the air. In Fig. 5 let f represent the required width of the armature surface in degrees, which will equal the arc of brush contact in degrees, and S the arc between the pole pieces, in degrees. The lines of force will in general follow a curved path to the nearest pole piece of opposite polarity. The length of the path from the middle of the neutral space to the nearest pole piece will be, roughly, $\frac{\pi S}{4}$. The area of this path, for a section of the armature core one inch long will be about equal, numerically, to $f \times 1$. The number of lines set up, per ampere-turn per inch length of core, will then be approximately:

$$\Phi = .4\pi \times 2.54 \times \frac{f}{\frac{\pi S}{4}} = \frac{4.1f}{S}.$$

This value is probably a trifle too small, since a number of experiments under working conditions have given an average of $\frac{4.5f}{S}$. These experiments included a number of motors and generators of from ½ to 50 kw, both multipolar and bipolar, and with the main field strengths varying from zero to a maximum. The smallest value observed was $\frac{4.f}{S}$, the largest $\frac{5.2f}{S}$.

In general, increasing the main field strength from zero to the maximum decreased the observed value of Φ by about ten per cent, due probably to the increased reluctance of the pole tips caused by their saturation.

Having both the ampere-turns and the flux per inch per ampere-turn, the total flux, if l represents the length of the armature, will be

$$\Phi = \frac{4.5f\,l\,NI}{S\,m\,P}.$$

The voltage generated by the short-circuited coils will be:

$$Vd = \frac{4.5f\,l\,N^2r\,I\,P_p}{S\,m\,P \times 10^8}.$$

Sparking will take place at any brush when no current is passing through it to an outside circuit, when the e.m.f. generated under that brush is 10 volts, if the brush is near the geometrical neutral point. This is an average value, depending upon the quality of the brush.

The complete formula for the armature current at the sparking point, therefore, becomes

$$I = \frac{10 \pm V_l}{\frac{6.3\,cr\,N_1^2\left[\left(4+\frac{1.6d}{w}\right)l_1 + l_2\right]P_p}{10^8\,m} + \frac{4.5f\,l\,N^2r\,P_p}{10^8\,S\,m\,P}},$$

where V_l represents the voltage generated under the brush due to the lead given it.

This of course gives the true current only when the brushes are set near the geometrical neutral point. If the brushes are given an excessive lead sparking is increased, since the proximity of the pole pieces increases the inductance of the commutated coils. The current at sparking is here taken as that value at which sparking becomes objectionable. The limit of complete sparklessness is when the sum of the reactive and distortion e.m.f. is about six volts.

A very interesting point is that the expression for Vd is not dependent upon the ratio between the field and armature ampere-turns. Hence if the dynamo is designed to carry its greatest load without moving the brushes from the geometrical neutral point, the reluctance of the air-gap may be made as small as is rendered desirable by other considerations, without regard to its effect upon the sparking point. In this case the geometrical neutral point is the point of least sparking under heavy loads, and sparking will not be reduced by moving the brushes in either direction.

It will be interesting to show the practical application of this formula to a concrete example. Following are the data of a 5-hp motor designed by the writer:

Horse-power, 5; volts, 240; speed, 1,000 r.p.m.; number of poles, 2; number of segments, 99; number of slots, 33; number of coils per slot, 3; number of turns per coil, 5; total number of conductors on the armature surface, 990; depth of slot, .75 in.; width of slot, .375 in.; gross length of armature iron, 4.5 in.; diameter of armature, 8 in.; total length of one turn of armature conductor, 32 in.; diameter of commutator, 6 in.; width of brush face, .5 in.; number of degrees covered by brush, 9.5; space between pole pieces, 50°.

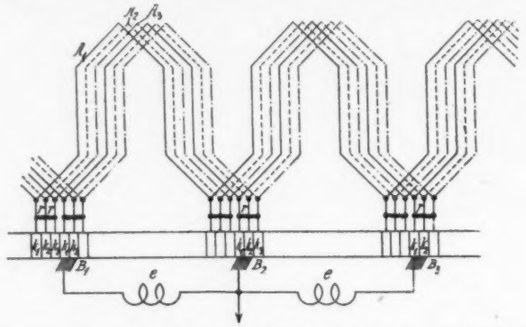
$$I = \frac{10}{\frac{6.3 \times 99 \times 16.7 \times 25\left[\left(4+\frac{1.6 \times .75}{.375}\right)9 + 21\right]}{2 \times 10^8} + \frac{4.5 \times 9.5 \times 4.5 \times 990^2 \times 16.7}{50 \times 2 \times 2 \times 10^8}}$$

$$I = \frac{10}{.123 + .157} = 36 \text{ amp.}$$

This corresponds very closely with the current at the sparking point of this motor, as determined by test.

Preventive Resistances with Interlaced Armature Windings.

The most serious disadvantage accompanying the use of interlaced armature windings for the purpose of preventing sparking in alternating-current commutator motors, is due to the fact that current is shifted from one winding to another as the brush passes from one commutator segment to the next. The sparking caused by interruption of the current in one winding may be as great as that which would have resulted from the short-circuit by the brush if a single armature winding had been employed. Messrs. Arnold and La Cour, in a patent issued Jan-



PREVENTIVE RESISTANCES WITH INTERLACED ARMATURE WINDINGS.

uary 29, describe a method of minimizing the sparking by arranging three interlaced windings in the same armature slots and interposing resistances between the commutator segments to which the individual windings are connected. When the method is applied to wave-wound armatures an electromotive force, equal to that generated in each armature coil by the fluctuation in the field magnetism, is introduced in the circuit interconnecting the brushes of the same polarity, as indicated in the wiring diagram.

Portable Wireless Outfits for U. S. Signal Corps.

By C. H. Claudy.

IF the men of the Signal Corps of the armies of '61-65 retain their interest in the work of their branch of the service, they must sometimes wonder at the work that they did, with the tools that they had. The Signal Corps still wig-wags and it still uses an army telegraph, but they are no longer the mainstays of intercommunication. The latest development is a portable wireless telegraphy apparatus, which has been perfected and is now being sent out in the field and being actually used.

The apparatus, which is shown in Fig. 1, weighs 320 lb. It

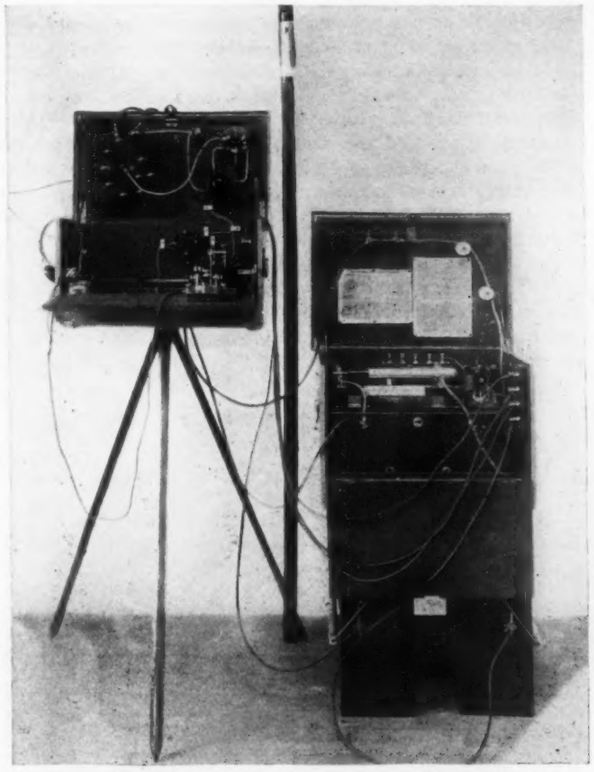


FIG. 1.—FIELD WIRELESS SET; JOINTED ANTENNA IN CENTER.

is a load for a mule, but can be taken apart and carried by hand. It is compact and designed to stand hard usage. The system used is a modification of several, but the detector, which is generally provided, is one with which Fessenden's name has been frequently associated, the acid cup and platinum wire drawn in silver.

The system uses two small cells of storage battery, capable of giving forth an impulse powerful enough to be read by a sister station at from 15 to 25 miles, and by a large station, such as the one at Cape Henry, at least 120 miles. The battery has a capacity of ten hours of actual sending, and can then be replaced by others or recharged.

The antennæ are supported by a 60-ft. pole, built up of six-foot sections, the copper wires fastened on the sides of the pole joining as the pole is fitted together. This pole can be erected and the rest of the apparatus unpacked and set up and messages forwarded in from 15 to 20 minutes from the time of starting. Captain Mitchell, at Fort Myer, has made a record of five minutes for the performance, but this short time presupposed highly trained men, working together in unison and with no hitches. It is evident that 60 ft. of antennæ pole is not sufficient

FIG. 2.—PORTABLE WIRELESS OUTFIT.

to raise the waves over very high obstructions, in the way of mountains or hills, and for this reason the erection of the apparatus on the top of a rise is indicated. But as the waves apparently follow the ground, the added height of a hill, unless very abrupt, does not materially add to the transmitting power of the instrument except to remove obstructing elevations.

It may be thought that a wireless station operated by storage battery is but limited in its scope, but it must not be forgotten that the parties using such an outfit are likewise limited in

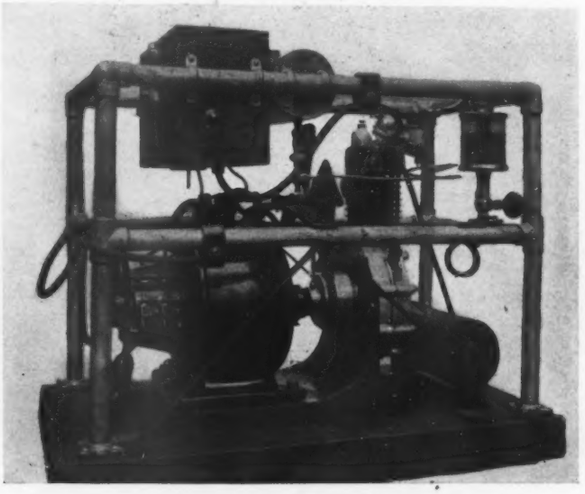


FIG. 3.—PORTABLE 2-HP GENERATING PLANT; WEIGHT 300 LBS.

their radius of action. It is proposed to furnish each division in the field with at least three and probably six sets of the wireless apparatus and to have one portable generator and 2-hp gasoline engine with each division. This piece of apparatus, although extraordinarily light for its capacity—weighing but little over 300 lb., is yet entirely too bulky for mule back and must be conveyed by wagon. But a division cannot move without supply trains and wagons; consequently wherever the division can go the generator can go also. Now, a brigade is detached and sent on flying duty somewhere, with two or three days' rations. The mules carry the wireless set and perhaps an extra set of batteries. By the time the rations are exhausted the batteries have run out, then it is necessary to recharge, but it is also necessary for the men to meet a supply train, and that solves the problem of the recharging, for where the supply train

is there is the division headquarters, and the gasoline generator outfit. This unit, of course, can be kept going at headquarters all the time, generating power for messages when not actually engaged in charging batteries. It is easily seen that this keeping in touch with headquarters by wireless enormously increases the effective range of any detached force from a squad to a division and enables them, by reason of their not having to lay a telegraph wire, or keep in touch with dispatches, to utilize more time and attain a greater effective range.

So far there have been six sets issued and one is now being made to pack in a trunk, even lighter than those already issued. It will be sent to the Signal Corps school at Fort Leavenworth, Kan. These wireless sets have all been constructed under the direction of and from plans made by the Signal Office at Washington, the experimental work and the laboratory practice being under the direction of Major Russel, of that office.

The acid wire detector is not the only one used, mica having been tried as well as the several other devices which have recently been brought out. The acid detector, however, although it must be filled, a wire inserted, adjusted and then emptied and cleaned, whenever the station is set up and taken down, is so reliable and so accurate that its use seems to be most in favor.

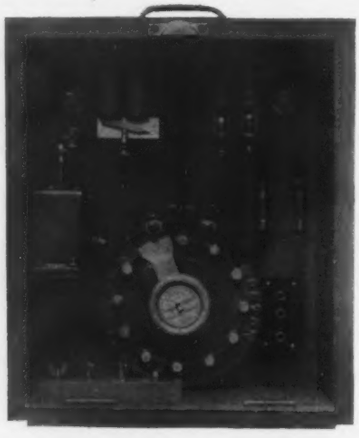


FIG. 4.—PORTABLE SWITCHBOARD.

The Signal Office does not in any way regard the apparatus as perfected and is at work now in making improvements, designed at once to simplify and to lighten the apparatus. At present it can be operated by any one with an elementary knowledge of the work, providing he adheres strictly to instructions, but the idea is not so much to make the machine fool-proof as it is to provide for its continued reliability under stress of work, travel and rough handling. With every instrument would naturally be detailed men trained in the handling of the apparatus. Further experiments are looked forward to with interest, and tests to be made in the field in the near future will doubtless furnish much material for change and improvement.

Motor-Converters.

Many attempts have been made within recent years to devise a satisfactory substitute for the rotary converter as a means of obtaining direct current when only alternating current is available. The motor-generator furnishes an excellent device, but is both more expensive and less efficient than the rotary converter. Our issue for December 23, 1906, contained a description of a "permutator" in which the armature is stationary and the brushes revolve synchronously, the revolving magnetism being produced by stationary polyphase windings that are inductively related to the stationary armature winding of the permutator. This Rouge-Faget machine exhibits the desirable characteristics of possessing a small mass of rotating material, and therefore can be rapidly synchronized. Moreover, the machine would neither experience nor produce any injurious effect if it were to fall out of step; its synchronizing power is enormous, so that the possibility of such occurrence is very remote.

A machine that can properly be designated as an alternating-current rectifier was described in our issue for January 12, 1907. As noted at that time, the rectifier operates to best advantage when used on electric locomotives for supplying to the motors pulsating direct current at variable voltage.

A third type of converter, and one for which many claims are

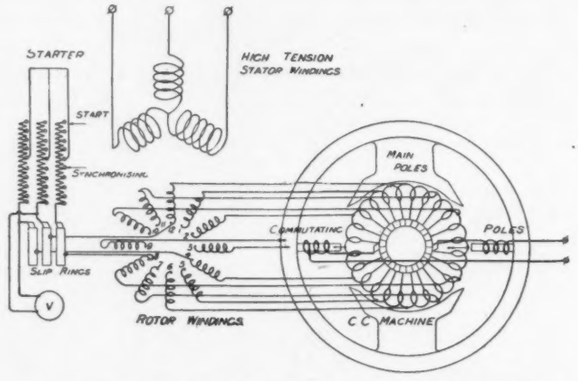


FIG. 1.—DIAGRAM OF CONNECTIONS OF MOTOR-CONVERTER.

made in connection with its advantageous characteristics when used to deliver constant potential direct current when the supply is high-frequency, high-voltage alternating current, was described in our issue for October 21, 1905. This machine has been introduced on a large scale for electric railway work in Great Britain, where it is stated that there are now more than four times as great capacity in use for 50-cycle current as there are rotary converters, although the latter have been available for at least four times as long. It seems desirable, therefore, to discuss at some length the properties of the machine that have led to its rapid introduction during the past two years.

As was stated in the issue referred to above, the cascade converter, or the "motor converter," as it is called in England, consists of two machine structures whose revolving parts are mounted on the same shaft. The input machine resembles in

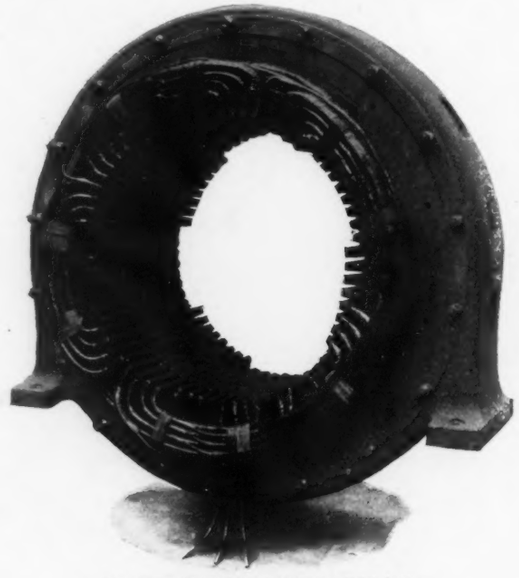


FIG. 2.—INDUCTION MOTOR PRIMARY.

every respect an induction motor with a coil-wound (rotor) secondary; the output machine is exactly similar to a rotary converter, and it receives its current from the secondary winding of the input induction motor at a frequency much reduced from that impressed upon the primary winding.

For simplicity in explanation it may be assumed that the motor and the converter have the same number of poles. Thus

the induction motor rotates at a speed corresponding to half frequency; half of the electrical power supplied to the induction motor will be converted into mechanical power and transmitted by means of the shaft to the converter, while the other half is transferred to the secondary (rotor) windings and thereby to the converter armature in the form of electrical power. Thus the induction motor operates half as motor and half as transformer, while the converter operates half as direct-current generator and half as rotary converter.

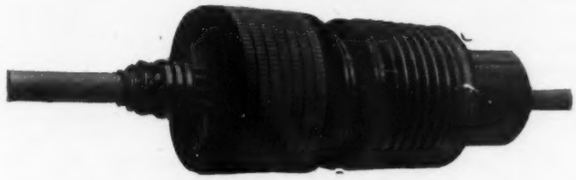


FIG. 3.—ROTOR WINDINGS.

The rating of the induction motor is theoretically half as large as it would be if it were to convert the whole of the electrical power into mechanical power, because its rating depends on the speed of the rotating field and not on that of the rotor. The converter runs at a speed corresponding to half the primary frequency, which is more advantageous with regard to commutation. Consequently its design offers less difficulty than would a rotary converter for the same output and primary frequency.

The secondary winding of the induction motor is generally arranged for 12 phases, as is also the alternating-current end of the rotor to which it is directly connected. In starting up the motor converter from the high-tension side, the primary winding is connected directly to the high-potential leads. Three taps on the secondary winding, corresponding to three phases, are brought out to slip rings by means of which an external resistance is inserted in this circuit during the starting period. The external resistance is gradually decreased as the speed of the machine increases. The machine thus starts up as an ordinary polyphase induction motor. Since the secondary windings of the induction motor are connected to points on the converter armature winding, the field of the converter is built up as

FIG. 4.—FIELD FRAME OF MOTOR-CONVERTER SHOWING COMMUTATING POLES.

though it were a direct-current generator. The voltmeter shown in Fig. 1 serves to indicate when a machine is running synchronously. It is stated that the synchronizing of a converter is so simple that no special skill whatever is required for its performance, the converter dropping into synchronism automatically a few seconds after the synchronizing notch of the rheostat has been reached. The current taken at starting varies from ¼ to ⅓ of the normal current and depends upon the magnetizing current of the induction motor.

The advantages of the motor converter for single-phase service are particularly marked because the synchronizing force of a single-phase set is practically as powerful as it is in a polyphase converter, this being due to the fact that the rotor of a single-phase converter is also wound with 12 phases. Furthermore, the difference between the efficiency of a single-phase and a polyphase motor converter is less than the corresponding difference in the case of rotaries of motor-generators. It is claimed that in comparison with a motor-generator the motor-converter is more economical in first cost and 2½ per cent more efficient in operation. In comparison with a rotary converter and the necessary bank of transformers, the motor-converter is about equally as expensive in first cost and has an efficiency 1 per cent less than the rotary equipment. The motor-converter is claimed to be better than the rotary converter for frequencies above 40 cycles on account of the improved commutation at the low frequency used in the direct-current portion of the machine. For lower frequencies, such as from 20 to 30 cycles, the rotary converter is evidently preferable. For all frequencies, however, the motor-converter possesses several characteristics which render it desirable even in comparison with rotary converters. Thus the motor-converter affords much better control of the voltage of the current delivered and it requires less skilled attention.

FIG. 5.—MOTOR-CONVERTERS IN SUB-STATION OF GREAT WESTERN RAILWAY.

The motor-converters shown in the accompanying illustrations were manufactured by Bruce, Peebles & Co., Limited, London, under the Peebles, Bragstad-La Cour patents.

New Telephone Patents.

SWITCHBOARD CIRCUITS.

Modifications of the various two-wire systems are being patented with great frequency. The latest is a modification of the Kellogg system by W. W. Dean, by which the cut-off relay severs but one side of the line. To accomplish this one side of the line is carried permanently to both the jack and line relay, the signal being controlled by cutting the lamp circuit.

A trunk circuit for use with two-wire systems forms the subject of a patent granted to H. M. Post, of Chicago, which is also assigned to the Kellogg Company. This circuit provides the usual signals for calling, supervision, guard and disconnect.

A magneto system convertible to common battery has been patented by A. H. Weiss, of Evanston, Ill. The magneto currents become effective upon relays which lock until released by the proper subsequent operation. The plugging in, in response to a line signal, unlocks and restores the line relay, while the throwing of the listening keys unlock the clearing relay.

H. G. Webster, of Chicago, has obtained a patent for a two-wire circuit system for switchboards, in which the relative resistance of the line, supervisory and cut-off relays entirely determine the action. Normally the cut-off relay of low resistance and the line relay or signal of high resistance, in series with battery are legged off the two sides of the line. The relative resistances are such that when the line is closed the current flowing through the relays in series actuates the line relay, but fails at the cut-off relay. A plug being inserted at the jack, the low-resistance supervisory relay is placed in shunt with the line relay, whereupon the cut-off relay gets enough current to operate and cut off the line relay at its contacts.

CALLING DEVICE FOR COMPOSITE SETS.

With composite sets it has been found quite impossible to ring by the coils except by the use of an auxiliary relay sensitive to high-frequency vibrating current. Fig. 1 shows a device

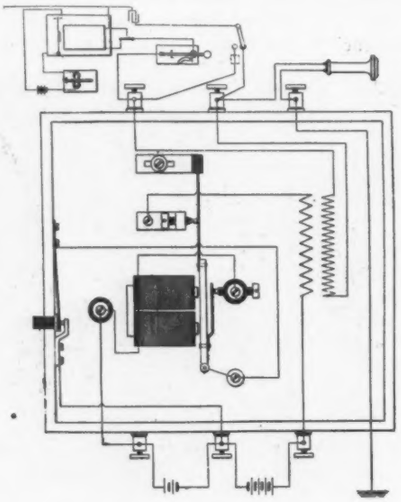


FIG. 1.—ADAMS-RANDALL CALLING SYSTEM.

invented by C. Adams-Randall for generating suitable vibrating current. The action is self-evident, being exactly that of a buzzer, with an extension vibrator.

LISTENING APPARATUS FOR TELEPHONE.

W. W. Grigsby, of Lawton, La., has invented a listening device for supervising operators. The sets are connected to the terminals of a contact dial, while the listening circuit is connected to the rotating arm trailing these. The arm is advanced by an electromagnetic device which is controlled from the listening station. By this means the listener may observe upon any circuit.

NEW APPARATUS.

Calling circuit keys for some gears have been made up in strips with removable buttons, the strips being of hard rubber. A key of this type modernized by being built up on a metal frame with rubber facing, forms the subject of a patent granted to W. Kaisling, of Chicago, and assigned by him to the Stromberg-Carlson Company.

G. W. Schuessler, of Mason, Texas, has devised a combined signal and jack. The signal resembles a drop without a shutter, carrying a plate on the hook. A weighted lever latches the hook up at the first pull of the armature. The insertion of a plug trips the latch and allows the lever and plate to fall to normal.

An antiseptic attachment has been patented by O. H. Savage, of New York City, which consists of a metal socket and cap pressed up to fit over the end of a transmitter mouthpiece. The cap is hinged and is so shaped that the walls of its central aperture project within the mouthpiece, forming an annular space between it and the mouthpiece. Within this space antiseptic filling may be placed.

R. W. Shoemaker, of Pasadena, Cal., has provided a call recorder for telephone stations. This is in the nature of a simplified type telegraph machine which may be made to print a record of the calling number.

At times, where with local battery transmission the receiver is left off the hook for considerable times, the battery becomes wasted. Because of this F. Edwards, of Jefferson, Iowa, has provided an auxiliary switch in the form of a locking key. This key when depressed closes the battery, and it locks if the hook switch is up. When, however, the hook is depressed, the key releases.

Carl G. F. Holmgren and A. E. Brahm, of Stockholm, have jointly patented a hand microphone designed with special reference to protecting the transmitter diaphragm. The mouthpiece is closed over except for some narrow slits about its edge. These are through the side wall of the mouthpiece, and are protected by a projecting flange.

INTERCOMMUNICATING SYSTEM.

A. K. Andriano has patented an intercommunicating system in which the connections are secret. Each station has a commutator switch. When desiring a party the switch is set correspondingly and the station rung. The called station then explores for the calling by turning his switch dial. When the correct position is reached a brief ring of the bells of both stations occurs. No one can listen in except the two stations desiring connection.

SWITCH HOOK.

Of late great ingenuity has been evident in the design of the small parts going to make up telephone sets. This, of course, is the result first of the keen competition between various manufacturers, and secondly, the increasing rate of output. Among the parts receiving particular attention has been the switch

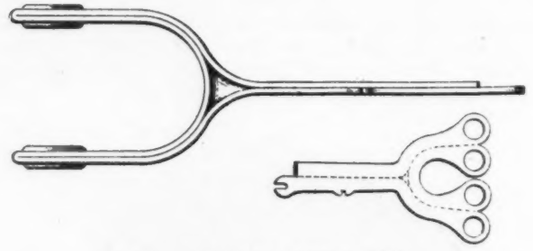


FIG. 2.—MANSON SWITCH HOOK.

hook. There are now numerous designs of this formed up of sheet metal and yet having the usual appearance of the old cast hook. The accompanying illustration shows the latest effort in this direction, recently patented by R. H. Manson, of Elyria, Ohio, and assigned to the Dean Company. The cut shows perfectly how the hook is made up to form a rigid lever.

Letter to the Editors.

Technical Graduates and Central Stations.

To the Editors of Electrical World:

Sirs:—I was very much pleased to note the discussion in your columns of the subject of technical graduates in relation to central stations. I think a statement of the existing conditions in this direction is very timely. There is need of an awakening among central stations to the fact that the graduates of technical institutions furnish most excellent material out of which to make plant managers and superintendents. The central station business is like any other business in this respect, that for its successful operation it demands of its manager an alertness

and up-to-dateness which will enable him to keep the business on a basis of successful competition with similar enterprises.

The central station manager should be a man who not only understands in a thorough manner the operation of the machinery installed in his plant, but one who is in a position to take a broad view of his business, one who is ready to develop the business along any avenue or in any direction which promises success. He must be familiar with up-to-date methods. He must be ready to adopt up-to-date appliances and at the same time be in a position to inspire confidence in his customers. He must also be a man of good address and be sufficiently familiar with the details of his business to explain the various appliances which in his business he installs upon the premises of his customers.

I am convinced that the technical graduate, because of his broad training, is especially adapted to fill such a position. It goes without saying that the average central station must be prepared to increase the salary of its superintendent if it expects to command this sort of talent, but it seems to me to require but little argument to convince one that such additional outlay would be spent to the best possible advantage in many of the central stations as they are operated to-day.

IOWA STATE COLLEGE, L. B. SPINNEY.
Ames, Iowa.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Invention of Dynamo Machine.—A letter by Mueller, formerly machinist of Siemens & Halske, with respect to the invention by Werner Siemens of the self-exciting dynamo in September, 1866.—*Elek. Zeit.*, January 24.

Lamps and Lighting.

New Incandescent Lamps.—An account of a continuation of the discussion of Swinburne's paper recently abstracted in the Digest. Fleming said that to arrive at the value of new lamps it is necessary to compare the new with the old, otherwise it is difficult to say how far the new are useful. In this connection the following figures have been obtained by Upson and others from observations in the Pender Laboratory (C = current, V = volts, W = watts):

TABLE 1.

Carbon Lamp.	Tantalum Lamp.	Osmium Lamp.
$Cp \propto C^{5.62}$	$Cp \propto C^{6.23}$	$Cp \propto C^{6.85}$
$Cp \propto V^{5.96}$	$Cp \propto V^{4.4}$	$Cp \propto V^{4.215}$
$Cp \propto W^{2.91\ to\ 3.34}$	$Cp \propto W^{2.87\ to\ 2.68}$	$Cp \propto W^{2.62}$
$Resist. \propto C^{0.064}$	$Resist. \propto C+^{0.29}$	$Resist. \propto C+^{0.38}$

Hence it appears that a positive resistance-temperature coefficient is of importance in keeping the voltage exponent low, and the effect of variations of pressure is then less noticeable. Another advantage of the metallic filament is that the Edison effect is diminished. This discharge is one of the difficulties in the making of high-voltage carbon lamps. On the other hand, with the metallic filament lamp there is the difficulty of obtaining small candle-power. The 8-cp, 200-volt lamp is a "distinctly precious possession," and the running of two or more lamps in series is by no means an equivalent. Further, owing to the paralyzing effect on the eye of the intense light of the very high temperature glowers it is necessary to use frosted globes, which cut the efficiency down to about half, and nullify the advantage of the higher candle-power. The common method of using a lamp, head-down, will not do for high-temperature lamps. There is a great deal of loss of useful light with the lamp in this inverted position. When a lamp is used in a horizontal position the light downwards is increased.—Solomon considered it most important to have lamps suitable for both high voltage and low cp; for this reason carbon is really the most suitable element for lamp filaments.—Munro has obtained very good results with osmium lamps of which 2,000 are in use in his district. For street lighting he places them on the trolley poles and in spite of their vibration and of the ordinary variation in supply these osmium lamps have an average life of over a thousand hours. A great number of his 50-cp lamps average from 800 to 1,200 hours and at the time the effective cp is within 10 or 15 per cent of the cp at which they started. Mackinney gave the results of life tests made at the Central Technical College, which are reproduced in Table 2:

TABLE 2.

Lamps.	Average consumption in watts per lamp.	Average consumption M.H.C.P. watts per lamp.	Specific consumption watts per candle.	Specific illumination Candles per watt.
New tantalum (run 48 hours)...	38.2	22.5	1.70	0.59
Old tantalum (run 1,012 hours)..	38.2	18.7	2.04	0.49
New "Osmi" (run 48 hours)....	34.9	21.0	1.66	0.60
Old "Osmi" (run 1,012 hours)..	34.1	21.0	1.62	0.62

Morris had obtained results given in Table 3.

TABLE 3.

Lamps.	Ratio of resistance hot to cold.	Ratio of initial current to final current (by oscillograph).	Voltage exponent.	Wattage exponent.
Carbon, ordinary	0.55	0.53	6.5	3.1
Tantalum, 27-cp, 110-v.....	6.3	4.6	4.3	2.5
Osmium, 25-cp, 55-v.....	7.9	...	4.6	2.7
Zircon, 31-cp. 110-v.....	8.9	6.0	4.0	2.5
Wolfram, 35-cp, 110-v.....	11.4 / 12.8	11.5	2.9	2.5*
Osram 28-c.p., 107-v.....	8.5 / 8.7	6.7 / 7.2	4.0	2.5
Osram 44-cp, 105-v.	12.9			

Fig. 1 shows the variation of the current and voltage immediately after starting a tantalum lamp. The current first rises to a maximum and then gradually decreases to its final value. This curve was taken with an oscillograph, a 110-volt, 22-cp tantalum lamp being used. In his reply Swinburne said regarding the tantalum lamp that the difficulties with alternating current are apparently due to crystallization. (His remarks on this point are more fully given in the account of the meeting in London *Elec. Times*, January 24, from which we quote the following: "The destructive effect on alternating current has been traced to the frequency, with which it varies directly, but they also point out that it is affected by the power factor. No doubt the rapid depreciation is the result of mechanical oscillation. We all know that changes can be brought about in iron structures from a similar cause, and the tendencies which are at work in a slender filament may no doubt be compared with those which in time affect a railway bridge.") Swinburne thought the new zirconium-tungsten lamp is very important, as it is the first 200-volt metallic filament lamp. It has been stated that the lamp is made of zirconium and tungsten, but he did not agree that it is an alloy at all, as alloys have a low melting point; it is more probably a zirconide. This lamp is possibly the first of a new series in which such compounds may play an important part.—Lond. *Elec.*, January 25.

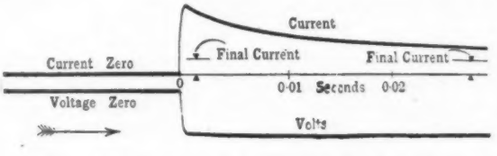


FIG. 1.—VARIATION OF CURRENT AND VOLTAGE.

Magnetite Arc Lamp.—HYDEN.—An illustrated article on the magnetite arc lamp with curves showing the distribution of light and comparative diagrams of two streets equipped respectively with ordinary alternating-current arc lamps and with magnetite arc lamps.—*Cassier's Mag.*, February.

Power.

Suction Producer Plant.—PORTE.—A paper read before the Dublin section of the (British) Inst. Elec. Engr. The author describes the production of producer gas and explains what precautions have to be taken to obtain good quality. He also deals

with the efficiency of a producer plant and gives the results of some tests. The paper concludes with particulars of faults likely to occur in practice, more particularly with suction gas plant.—Lond. *Elec.*, January 25.

Electrically-Operated Sinking Plant.—An illustrated description of the electrically-operated sinking plant recently installed at Wilhelmina Pit of the Dutch State Mining Department, near Haarlem. In sinking the shaft by the refrigeration process, it was anticipated that water would be met with, and that sinking pumps would have to be kept in readiness. High-pressure centrifugal pumps, directly coupled to three-phase motors were adopted for this purpose. Three-phase currents at 2,000 volts are used for power purposes.—Lond. *Elec. Rev.*, January 25.

British Power Companies.—Statistical tables on the equipment of 14 large electric power companies in Great Britain with maps of the areas served.—*Supplement to* Lond. *Elec.*, January 25.

Switzerland.—Bignani.—An illustrated article on recent hydraulic power developments in Switzerland referring especially to hydro-electric developments in the Canton of Vaud.—*Cassier's Mag.*, February.

Coal.—Abbott.—An illustrated paper on some characteristics of coal as affecting the performance of steam boilers. The author discusses the effects of various sizes on efficiency. Numerous useful tables and diagrams are given.—*Mines and Minerals*, February.

Traction.

High-Voltage Railway Insulators.—A note on the new insulator for railway work. In this insulator the outer cover (for protection against rain) is made of insulating material, and not, as in general, of metal. The protection against surface leakage is, therefore, much greater than the usual tramway insulators. The insulated bolt is fixed into the cover mentioned above, over which a metal cap acting as the support is pressed on; between this metal cover and the head of the bolt an insulating disc is fixed. For e.m.f's not exceeding 15,000 volts two of these insulators are placed on the pole-arm about 5 ft. apart. These are connected by a transverse wire, at the middle of which is fixed a third insulator carrying the trolley wire. This arrangement considerably increases the insulation resistance of the trolley wire from earth. These insulators are able to withstand from 40,000 to 50,000 volts when dry, and from 20,000 to 24,000 volts when exposed in artificial rain, without breaking down, and they are able to support a vertical pull of 2,500 kg. (5,500 lb.) without the insulation being damaged. These insulators are being tried on the Vienna Metropolitan Railway.—Lond. *Elec.*, Jan. 25.

Electric Railway in Greece.—A note on the conversion of a short line from Athens to Piræus to electric work. Three-phase currents are generated at Athens by three 750-kw sets, working at 5,500 volts and a frequency of 50 periods. The high-tension alternating current is converted to continuous current at 250 volts (the working voltage) in substations. The line is equipped with a third rail, except for a short length in Athens, the line is above ground. There are at present four motor-trains of a type similar to those used on the Metropolitan Railway in Paris.—Lond. *Elec.*, January 25.

Track Construction.—Dubs.—A report to the International Tramways and Light Railway Association. The report is based on the replies received from different companies on sending them blanks with a series of questions. A large number of systems of foundation, superstructure, jointing, electric connections and construction of crossings in Europe are described and their advantages and disadvantages are discussed. The paper is to be continued.—Lond. *Elec.*, January 25.

Canal Haulage.—Thwaite.—The conclusion of his illustrated article on the evolution of canal electrification methods. The author discusses the French experiments with the "automobile canal tractor" and with a Douai electric canal tractor system, also the American experiments on the Erie canal with "Wood's modification of the Thwaite-Cawley system." The British Thwaite-Cawley system of "proportional adhesion" is finally described.—Lond. *Elec. Rev.*, January 25.

Single-Phase Traction.—A fully illustrated article on the single-phase locomotives on the Seebach-Wettingen line installed by the Oerlikon Company. The wiring and the methods of regulation are described and the results of some tests are given together with notes on the construction of the locomotives and of the transmission line.—*Elek. Zeit.*, January 24.

Petrol-Electric Transmission for Road Vehicles.—Hart and Durtnall.—The first part of an illustrated paper read before the (British) Society of Motor Omnibus Engineers. The internal-combustion engine is wanting in elasticity and, in order that it may be satisfactorily adopted, some sort of variable speed-changing device is necessary. The system usually employed in petrol-electric systems is that of a dynamo, coupled direct to the engine, which furnishes current for an electric motor, coupled mechanically to the road wheels, the vehicle being actually an electric car with the engine and dynamo supplying the electric power in place of the ordinary battery of accumulators usually employed. Petrol-electric cars possess the inherent advantages of not being restricted to a given radius of action, of requiring no recharging, as in the purely electric systems, and of being able to run the same distance as an ordinary petrol and geared car. Of the existing direct-current systems the following are described in the present installment: Dowsing, Germain, Fischer, Hart-Durtnall, Astle-Wallis, Stevens and Cerolan.—Lond. *Elec. Times*, January 24.

Electric Automobiles.—de Valbreuze.—A long illustrated classified review of different systems of electric automobiles.—*L'Eclairage Elec.*, January 26.

Installations, Systems and Appliances.

Protection Against Atmospheric Discharges.—The report, signed by Benischke, of the Committee of the Berlin Electrical Society on the protection of electric installations against atmospheric discharges. Plans with a series of questions were sent out to transmission lines in Germany and a total of 204 answers were received during the last two years. It seems that the number of accidents has decreased on account of better protection although it is evident that an absolutely reliable protection against atmospheric discharges does not exist. In some cases an accident happened to the line, although the lightning arrester did act simultaneously. Some notes are given on improvements obtained by means of induction coils in combination with horn lightning arresters.—*Elek. Zeit.*, January 24.

Alternating-Current Service.—Knowlton.—An article discussing the special field of usefulness of alternating-current service with particular reference to the use of the single-phase electric motor. The author considers that the present alternating-current field is in suburban or sparsely settled districts.—*Cassier's* Mag., February.

Wires, Wiring and Conduits.

Hard-Drawn Copper Wire.—Bolton.—The British Engineering Standards Committee in their report issued a short time back defined hard-drawn copper wire as that which will not elongate more than 1 per cent without fracture. But if elongation is measured up to actual fracture the percentage depends largely on the length of the test piece. Further, the test pieces ordinarily employed are not more than 8 to 10 in. long, and, the total elongation to be measured being very small, there is little doubt that although fairly uniform measurements are obtained, the readings are largely affected by unavoidable sources of error, and are a good deal higher than they should be, since it has been found that very much smaller figures are obtained by careful experiment upon pieces many feet in length. The process of drawing has a double effect on copper, viz., to increase the tensile strength and to increase the elasticity. The latter effect is almost nullified by subsequent annealing, and the former partially so. The action appears to be to some extent superficial, as the effect is less on a wire of large diameter than on one of small diameter whose area is, of course, smaller in

proportion to surface. If, therefore, all sizes of copper wire were prepared with the same proportional amount of hard-drawing, their properties would still be different. In practice, however, the difference is magnified to a slight extent by economic reasons. For instance, supposing a wire 1/16 in. in diameter to be drawn from a rolled rod ¼ in. in diameter, it would be necessary to draw a ⅜-in. trolley wire from a rod 1½-in. in diameter in order to give it the same proportional reduction of area. Naturally to do this would require the employment of very heavy drawing machinery, and the cost of the process would be very considerable. It is customary, therefore, to draw each size of wire to such an extent as shall give ample strength for the purpose for which it is to be employed, without increasing the cost of the thicker sizes to an extent which would not be warranted by the slight increase of strength obtained. In Fig. 2 are given the curves of seven different sizes of wire,

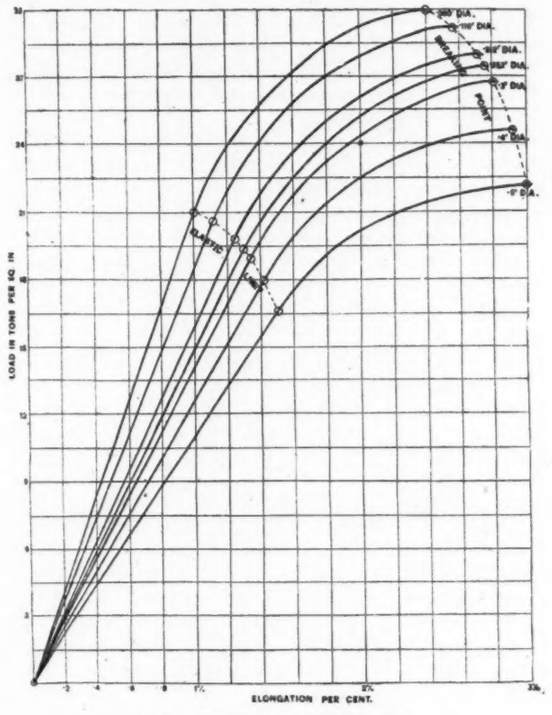


FIG. 2.—CURVES OF SIZES OF WIRE.

which are fairly typical of the whole range of sizes in use. A glance at this diagram gives a fair idea of the gradual alteration in the behavior of wires under tensile stress between the limits of size used for overhead work. It will be seen that while at No. 14 S.W.G. (.080 in. diameter) an ultimate strength of 30 tons per square inch is reached, that of No. 7/0 S.W.G. (.5 in. diameter) is only 22.4 tons, the elongation at fracture rising from 2.2 per cent in 10 in. on the first named to 3 per cent on the latter. The elastic limit follows the breaking stress in a fairly constant ratio. The essential difference between hard-drawn and soft copper wire is in elasticity, and it would appear that if a short definition of the former is wanted in order to point out this distinction, it can be best described as copper wire, of which the elastic limit under tensile stress is not less than 60 per cent (or 70 per cent) of the breaking load. For the purpose of a specification the breaking stress affords a more convenient basis than elongation. The author recommends the specification by the English Post Office for overhead line wires, viz., "that all wire shall stand wrapping in six turns round its own diameter, unwrapping and wrapping again in the same direction without fracture." This specification should be coupled with the requirement of sufficient tensile strength. Figures for the latter are necessarily empirical. Fig. 3 shows graphically the variation in the strength through the whole ranges of sizes of wires employed, the ordinates representing sectional area and the abscissæ the corresponding strength per unit of area. The full line is plotted fom the average values obtained from a large number of tests of wires of the best electrolytic copper. The dotted line shows the minimum strength suggested for a working specification. Finally a table is appended giving for all gauges properties which it is considered that engineers may reasonably insist upon as a minimum govern-

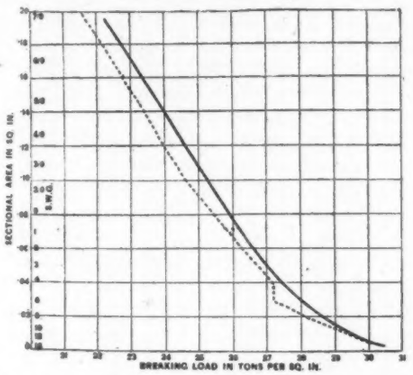


FIG. 3.—CURVES OF STRENGTH VARIATIONS.

ing their supplies, and it is suggested that of these the figures for tensile stress alone be taken for testing purposes, coupled with the Post Office wrapping test described above, and, if desired, with the approximate elongations.—Lond. *Elec. Rev.*, January 25.

Electro-Chemistry and Batteries.

Fusion and Firing of Refractory Materials.—HUTTON.—A paper on electric heating and its application to the fusing and firing of refractory materials. The author first describes laboratory and experimental furnaces for the investigation of various problems important for the pottery trade, and then deals with industrial electrical furnace processes for making corborundum, artificial graphite, fused alumina, magnesia and silicate glass, with special reference to the manufacture of crucibles, bricks, etc., from these materials.—*Transactions of the English Ceramic Society*, Vol. 5, Part 2.

Electrolytic Caustic and Chlorine Plant.—CROCKER.—An illustrated description of a plant for electrolysis of common salt of a large paper company, the cell used being that of McDonald.—*Electrochem. and Met. Ind.*, February.

Aluminum Anode.—CORBINO.—An optical study of the thin film formed by electrolysis on an aluminum anode. Its thickness was found to vary between 0.000013 and 0.00003 centimeter. —Lond. *Elec.*, January 25.

Calcium Cyanamide.—CARLSON.—Instead of making calcium cyanamide from carbide and nitrogen, he mixes the carbide with calcium fluoride.—*Chem. Zeit.*, December 19.

Units, Measurements and Instruments.

Light Standards.—PATERSON.—The first part of a paper read before the (British) Institution of Electrical Engineers on investigations carried out at the (British) National Physical Laboratory. The first gives a comparison of the three flame standards—Harcourts 10-cp pentane standard, the German Hefner candle, and the French Carcel standards and discusses at length the influence of atmospheric conditions, especially the effect of the amount of carbon dioxide, of the amount of water vapor, of the proportion of nitrogen and oxygen in the air and of the barometric pressure. After a description of the three standard lamps he summarizes the results of the comparison of the three lamps made simultaneously in England, Germany and France. They are given in the following table:

	Pentane.	Hefner.	Carcel.
National Physical Laboratory	1	0.914	0.982
Reichsanstalt	1	0.917	0.991
Laboratoire Centrale	1	0.929	1.000
Laboratoire d'Essais	1	0.928	0.996

In criticising the three lamps as standards of light the con-

stance of the Carcel lamp from day to day is not comparable with that of either the Hefner or pentane lamps, its variations from the mean being as much as + or — 3 per cent. The reason for this can only be attributed to the difficulty in reproducing the same conditions of capillarity in the wicks used. The Hefner lamp is much simpler in general construction, smaller and more easily set up and should be simpler to manufacture and to adjust to standard dimensions than the Harcourt pentane lamp. On the other hand the pentane lamp has a whiter light than the Hefner unit and the fact that its candle-power is eleven times that of the Hefner candle makes it of the same order of magnitude as the ordinary lamps which are tested against it. These two factors, coupled with the greater ease of adjustment when making observations with the pentane lamp, greatly outweigh, in the author's opinion, the disadvantage of the more complicated construction and the larger correction that has to be applied for changes in barometric pressure. The author then gives the results of tests of large-bulb, low-voltage Fleming Ediswan incandescent lamps. Ten of them designed for use as laboratory standards were tested for periods varying from 400 to 600 hours. The curves of two typical lamps are given in Fig. 4. The consumption of these lamps is initially about 4.5

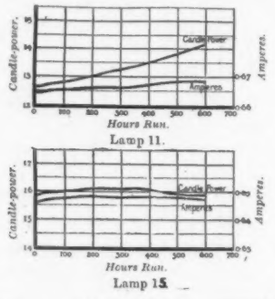


FIG. 4.—CANDLE-POWER CURVES.

watts per candle, and 4.3 watts after 500 hours. When compared with the life curves of ordinary lamps it is remarkable over what a long period the initial rise in candle-power lasts. This is especially evident from "lamp 11," where there is no sign after 600 hours of any diminution in the rapid rate at which the candle-power is rising. Lamp 15 has the best curve. The first point which is evident from an inspection of all curves determined by the author is that the performance of filaments specially prepared for constancy cannot be predicted with certainty. If a lamp is to be used as a photometric standard of the first grade its history for 100 to 200 hours should be known, and its life curve should be closely watched in order to ascertain the point at which it is beginning to flatten out. If the only photometric standards required were of the low-voltage type the problem might be considered as solved. A properly-aged specially-prepared low-voltage filament, if burnt for, say, 10 minutes a day for five days in the week, should last two or three years without changing by half of 1 per cent in candle-power, provided that no excess voltage is applied. Where, however, the only source of supply is a high-voltage variable circuit, it is essential that the standard and the test lamp shall be run in parallel, so that the effect of voltage variations may be reduced to a minimum. This entails either the use of a low-voltage lamp with a fixed resistance in series or a high-voltage lamp of reasonable constancy. The method of putting a resistance in series with a low-voltage lamp and running on a high-voltage circuit is not so satisfactory as it might appear at first sight. The resistance must dissipate some 60 watts and must keep constant to 0.1 per cent if the candle-power is to be correct to 0.5 per cent. If, further, the voltage variations on the circuit are great, it is essential that the temperature coefficient of the resistance shall be the same as that of the lamp. High-voltage lamps which remain constant for a considerable time would be desirable, but they cannot yet be produced with certainty. By trying a number of special lamps some may be found which are in every way as good as low-voltage standards; but at present the only alternative to this is to select a lamp with as small and as regular a drop as possible, and rely on restandardization after about 20 hours' running. It should not be necessary to run a standard under ordinary conditions for longer than 45 minutes per week in all. In this case restandardization would only be required every six months.—Lond. *Elec.*, January 25.

Thermometers and Pyrometers.—Whipple.—An address before the Syracuse Chemical Society on different types of pyrometers, especially expansion thermometers, thermo-electric thermometers, electric resistance thermometers, radiation and optical thermometers, calorimetric thermometers and fusion thermometers. Various industrial applications, for instance, in the heat treatment of steel are discussed.—*Iron Age*, February 7.

Method of Pirani.—Silva.—A mathematical note in which the author remarks that calculations on the method of Pirani generally suppose that the self-induction of the galvanometer is negligible compared with that of the induction coil employed. While this is a simplification of analysis, a doubt remains whether it does not involve an error. The present author shows mathematically that the formula of Pirani is always independent of the self-induction of the ballistic galvanometer.—*L'Eclairage Elec.*, January 26.

Measuring Power in Three-Phase Systems.—Orlich.—For calculating the power in a four-wire, three-phase system Aron and Stern have given formulas which are claimed to be exact. The present author shows that this is not so since in the same the supposition is made that at any moment the sum of the e.m.f's in the three phases is zero. This is not necessarily so. Since these formulas are often used in the design of meters the present author gives the corrected formulas.—*Elek. Zeit.*, January 24.

Electron Theory.—Fournier d'Albe.—A Faraday Society paper on the application of the electron theory to electrolysis. The author discusses the actual constitution of a single ion and thinks that the future development of the theory will lie in the direction of statistical analysis or kinetic principles.—Lond. *Elec.*, January 18.

Telegraphy, Telephony and Signals.

Submarine Signalling by Means of Sound.—An illustrated article describing the development of submarine signalling by means of sound, and the latest successful application of the system at Liverpool. The method consists essentially of a bell as a transmitter and a tank containing a solution and a microphone as receiver. The great advantage of the system is that by having a receiver on both bows of a ship the direction of a warning can be determined, and a course steered in foggy weather much more accurately than by sounds transmitted by the atmosphere.—Lond. *Elec.*, January 25.

Telephone Lines in Snow.—Bare telephone wires, if laid on ice-covered ground, will work quite well without any further insulation. The effect has often been tried of removing the wires from the poles at the first approach of snow and placing them direct on the ground to avoid breakage by storms or by the weight of ice. Last September the lines going through the Bavarian mountains were taken from the tops of the poles and fixed to insulators about 50 cm. (19.7 in.) from the ground. Short stakes were also driven in between the original poles to serve as an extra support. Where the lines crossed roads they were laid underground.—Lond. *Elec.*, January 25.

Electric Clock and Telegraph.—An illustrated description of the electric clock and telegraph installation at the Liverpool cotton exchange. There are 120 clocks, all in series and all driven by one controlling pendulum. The arrangement of wiring is described together with the precautions taken to prevent a breakdown. The telegraph installation consists of a system for telegraphing the prices as they fluctuate to the various suites of offices in the building. The system is an adaptation of the original Wheatstone A. B. C. working with figures and letters direct.—Lond. *Elec. Rev.*, January 25.

Central Battery System.—Neuhold.—Some notes on methods of wiring with central battery systems.—*Elek. Zeit.*, January 24.

Telephone.—Maver.—An illustrated popular article on the

widening applications of the telephone in everyday life.—*Cassier's Mag.*, February.

Telegraph Cable.—MULLALY.—The first part of a Franklin Institute paper giving historical notes on the laying of the first Atlantic telegraph cable fifty years ago.—*Jour. Franklin Inst.*, February.

Miscellaneous.

Electric Welding.—A note on the Prescot system of electrically welding metal pieces of comparatively small section; that is, the largest size rods or wires which can be welded are for iron and steel ¾ in.; for brass, 9/16 in., and copper, ⅜ in. The advantages claimed are that most of the troubles met with in hand welding are done away with, and that highly skilled labor is not necessary. The system which is illustrated in Fig. 3

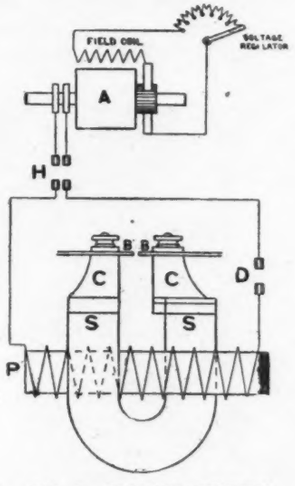


FIG. 5.—ELECTRIC WELDING.

includes an alternator, *A*, connected through switches *H* to the primary, *P*, of a transformer. The secondary, *S*, of the transformer is a massive single convolution terminating externally in two heavy clamps, *C*, which grip the two wires, *B*, to be welded. When the switches are closed the generator supplies a "moderate current" at about 100 volts to the primary of the transformer in which the voltage is greatly reduced with a corresponding increase of intensity of the current. At the point of junction of the two wires, *B*, there is produced a slight bulge on the metal, which is easily trimmed by filing or by an emery wheel. The great advantage of the method is that the heat is produced only at the point of welding.—Lond. *Elec. Times*, December 13. Two methods, one devised by Egel and the other by a Hungarian company, for welding together thin metal sheets are described from Austrian patent specifications in *Elek. und Masch.*, December 30.

British Exports.—Classified tables of the registered exports of British and Irish electrical goods from the United Kingdom and of all imports of electrical goods into the United Kingdom from other countries. The imports are greater than the exports in case of electric lighting fittings and accessories, electric lamps, carbons and telegraph and telephone material.—Lond. *Elec. Rev.*, January 25.

BOOK REVIEWS.

BASES D'UNE THEORIE MECANIQUE DE L'ELECTRICITE. By Seligmann-Lui. Paris: H. Dunod and E. Pinat. 208 pages, 47 illustrations. Price, 3 francs.

An attempt is made in this pamphlet to explain all electric and magnetic phenomena on purely mechanical grounds. Physical laws are submitted to mechanical treatment and no physical hypothesis is accepted if not in harmony with the fundamental principles of rational mechanics. The 200 pages of this closely-printed work bristle with mathematical symbols; and it must be said that the conclusions reached by the author, a distinguished French engineer, on the nature and utilization of electrical energy are interesting. If he criticises Maxwell, he does not spare Lagrange.

PRÉCIS D'ELECTRICITÉ. By Paul Niewenglowski. Paris: Gauthier-Villars. 200 pages, 64 illustrations. Price, 6 francs.

Though this work bears the title of *précis*, it nevertheless treats of all the general phenomena of electrostatics and current electricity. The treatment is succinct, it is true, but clear. The essentials of every important theory are given, unimportant details being studiously omitted. The first part covering 96 pages is easy reading; the second of 94 cannot be tackled without a practical knowledge of the calculus, which knowledge is, of course, indispensable to any useful apprehension of potential, induction, electromagnetism or electronic phenomena. To students of engineering possessing such a mathematical equipment, this work will be eminently serviceable.

L'ELECTRICITÉ A L'EXPOSITION DE LIÈGE. By J. A. Montpellier, Rédacteur en Chef de l'*Electricien*. Paris: H. Dunod et E. Pinat. 506 pages, 238 illustrations. Price, 18 francs.

This voluminous and well-illustrated work contains a consecutive account of the progress made in the more important branches involving the generation and use of electric energy. The first part of the volume treats of the dynamos, alternators, steam-engines and gas-engines that were exhibited at the Exposition held at Liège in 1905 to commemorate the 75th anniversary of the proclamation of the Belgian independence. No less than 32 foreign countries took part in the Exposition, while the number of exhibitors amounted to 14,000.

The other parts of the work are devoted to *mechanical* applications such as electric motors, traction, telegraphy, telephony; *chemical* applications, such as electrochemistry and electro-metallurgy; *thermal* applications, such as electric furnaces, lamps, fuses and detonators. The last part is reserved for measuring instruments adapted for use in laboratories and central stations.

This work of M. Montpellier is an excellent repertory of the most recent productions of electrical industry especially in France and Belgium.

ANNUAIRE POUR L'AN 1907. Published by le Bureau des Longitudes. Paris: Gauthier-Villars. 854 pages. Price, 1.50 francs.

Besides the tables of physical constants and astronomical data given in this yearly publication, there are three articles on astrophysics by French astronomers of European celebrity. The first is on the diameter of Venus by M. Bouquet de la Grye, in which the distinguished author concludes that the planet rotates on its axis in a short period similar to that of the earth as against Schiaparelli of Milan, who makes the time of rotation the same as the period of revolution, as in the case of Mercury and our Moon. The second article is by the same author and contains an account of the work of the meeting of the International Geodetic Association held at Budapest last September, which was attended by 61 delegates representing 19 states.

The last article is from the pen of M. Deslandres, in which that astronomer and master of the subject gives, in a lengthy paper of 30,000 words, the history and present state of our knowledge of the constitution of the sun as well as the nature of each of the envelopes that compose the solar atmosphere. A translation of this paper would be very useful to the general student of solar physics.

ELEMENTARY ELECTRICAL ENGINEERING. By J. H. Alexander. New York: D. Van Nostrand Company. 208 pages, 181 illustrations. Price, $2.00.

This book is intended for class work by junior and senior students and by practicing electricians. The subject matter has been condensed from a series of lectures upon electrical engineering delivered by the author to evening classes of young artisans in a large manufacturing town. The treatment is characterized by simplicity and brevity, and for the most part is accurate. The elementary explanations, with several glaring ex-

ceptions, are correct and to the point. On page 70, in answer to the question: What actual quantity of current passes, when a dynanometer shows a current of 30 virtual amperes? we are informed that 42.3 amperes pass per second. Just what idea the author wishes to convey by the above question and its answer, we do not know, but it cannot be doubted that the whole problem is erroneous, and is misleading to one unacquainted with the facts. The author seems to have his own peculiar ideas as to the internal action of a transformer, when he strongly intimates on page 100 that in a step-down transformer the primary current is small because the "primary resistance is high." Moreover, he makes the common error of assuming that the primary current "induces a current in the secondary." It would be unjust to estimate the author's own knowledge of electric phenomena solely by these exceptions, but the fact remains that the information conveyed to the mind of the reader often depends more upon the expressions used in the book than upon the knowledge actually possessed by the writer. For this reason extreme care should be exercised in the preparation of a book intended for students who have no means for ascertaining the facts other than the book alone. The present book can be recommended for reference by a student who is able to attend lectures upon elementary electrical engineering, and a discerning reader will find much of value in the book as an assistance to study at home.

Fields of Force. By W. F. K. Bjerknes. Publication Number One of the Ernest Kempton Adams Fund for Physical Research, Columbia University. New York: The Columbia University Press: The Macmillan Company. 160 pages, folio, 23 figs., 4 plates.

This handsome folio is the first publication issued under the terms of "The Ernest Kempton Adams Fund," which was established by Mr. Edward Dean Adams, December 17, 1904, in memory of his son, who was graduated from Columbia University with the degree of E. E. in 1897, received the degree of A. M. in 1898, and devoted his life to scientific research. The volume is a fine specimen of the printing art, both in style and in mechanical execution. The series to which it forms the initial contribution should through accretions in course of time become a valuable record indispensable to the library of every institution of higher scientific learning in the world, and worthy of the memory of the brilliant young man whom death removed just as he was embarking on a career full of the highest promise.

These 160 folio pages contain the substance of eight lectures given at Columbia University between December 1-23, 1905, by Prof. Bjerknes of the University of Stockholm. The term "Fields of Force" is given a little more elasticity in these lectures than usual so as to include not only electric, magnetic and electromagnetic fields, but also such as may exist in other material media such as water, the sea and the atmosphere. The first two lectures are devoted to the development of these latter hydrodynamic fields of force both by elementary reasoning and by experimental demonstration. The other lectures are mainly concerned with the mathematical treatment of the subject, which requires for their appreciation familiarity with vector analysis and also the ponderous pages of Oliver Heaviside.

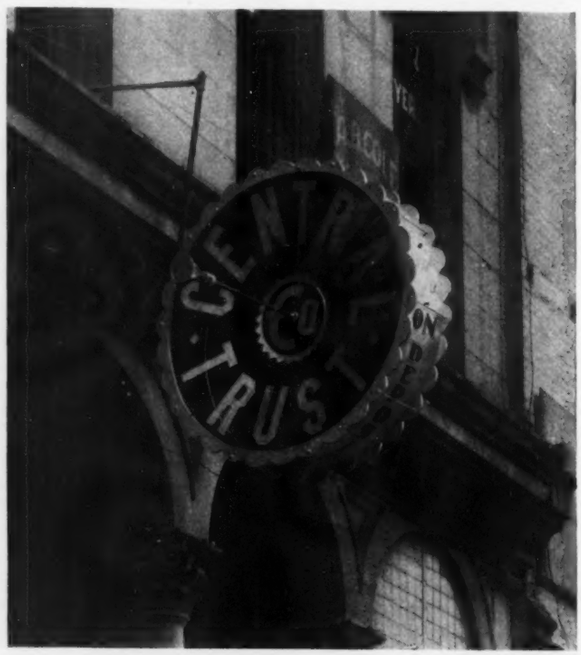
Prof. Bjerknes freely recognizes that our knowledge of the fundamental nature of any field of force is incomplete. On p. 29, for instance, he tells us that Faraday's idea of a tension parallel to, and a pressure perpendicular to, the lines of force is merely hypothetical; on p. 57, he frankly admits that we do not know the physical nature of the two constants by which we seek to define the properties of a material medium; and on p. 57, after remarking that our knowledge of electromagnetic fields is contained in Maxwell's theory, he proceeds to say that "this theory does not tell us what electromagnetic fields are in their true nature."

Those who attended the first of these lectures and witnessed the simple means employed to illustrate by small air-pumps and by pulsating elastic membranes immersed in water, the phenomena of magnetic fields and their interference, must have been impressed, as indeed the writer was when, many years ago, he attended a similar demonstration by Prof. Bjerknes *père* in London.

These lectures by Prof. Bjerknes are unquestionably a valuable contribution to the physics of the electromagnetic field.

The Day and Night Circular Sign.

A circular sign, which is coming into the extensive use at Indianapolis and was exhibited at the recent Chicago Electrical Show, is shown in Fig. 1. The background of this sign is black wire gauze to which letters painted with aluminum paint are attached. This makes the letters stand out well when illuminated by night as well as by day. The illumination at night is secured by an incandescent lamp with a reflector for hiding the lamp from the eye of the observer and throwing the



CIRCULAR SIGN AT INDIANAPOLIS.

light onto the letters. A larger and deeper reflector than shown in the illustration will probably be used in the future. The sign is well suited to customers who cannot afford to pay for the operation and maintenance of a sign with many lamps upon it, and probably represents the maximum advertising effect that can be obtained from a pair of incandescent lamps. Of course, lamps of any size or candle-power can be used. The Buschmann & Griffey Company, K. of P. Building, Indianapolis, Ind., are the United States agents for this sign.

Ridgway Dynamo and Engine Works.

The Ridgway Dynamo & Engine Company has just completed a large addition to its works at Ridgway, Pa., and is now putting it into service. The addition is a one-story building, located immediately in front of and connected to the main machine shops. It is of steel construction, approximately 200 ft. long and 65 ft. wide, with solid brick walls and slate roof. The floor is of wood, laid on stringers bedded in concrete.

A 30-ton crane, with a 5-ton auxiliary, serves the entire floor. The motors on the crane are of the series type with "Thompson-Ryan" balancing coils and were built by the Ridgway Company. The side and end walls are well supplied with large windows and the central part of the roof is filled with

skylights. Artificial lighting is secured by flaming arc lamps suspended from the roof trusses, and clusters of incandescent lamps on the walls. A heating system, using exhaust steam from the shop engines, is being installed and this system will be continued to include the entire works.

The building will be used as an erecting shop and storage for finished machinery. A switch from the Pennsylvania Railroad runs through one side of the building, making it easy to load and unload material from cars by means of the crane.

The total floor space in the entire works now amounts to three acres. Seven overhead traveling cranes are in constant use serving seventy-five per cent of the floor space. In addition, all hoists are installed wherever they can be used.

The entire machinery of the works is driven by electric motors, all of the larger machines being provided with individual motors and the smaller machines driven in groups by motors of from 10 to 30 hp. Compressed air at 80 lbs. pressure is piped to all parts of the plant for operating molding machines, hoists, drills, hammers, etc. All parts of the shop and office are connected by an intercommunicating telephone system. The completion of the erecting shop furnishes much needed relief to the overcrowded machine shop, and makes possible the more economical and rapid handling of work.

Automatically Locking Attachment Plug.

The attachment plug illustrated herewith renders the rotation and twisting of the cord for either insertion or removal unnecessary. A sharp thrust with a slight rotation to the left allows the corrugations to match the threads in the socket shell. A

WIZARD ATTACHMENT PLUG.

slight rotation to the right insures contact. It automatically locks itself. It may be disengaged and detached with the pressure of three finger tips. There is no rotation; the parts are merely compressed and withdrawn. The plug is made by the Benjamin Electric Manufacturing Company, New York.

Dry Cells for Special Duties.

Manufacturers of dry cells are now specializing in this work for various forms of service, endeavoring thereby to secure the greatest efficiency and longest life. The Stackpole Battery Company, of St. Marys, Pa., has recently introduced a new line which covers all the requirements of both light and heavy duty. Two of these cells are particularly adapted to gas engine sparking, the Autocrat No. 6 being intended for all-around ignition work and the Radium cell for extra heavy work of this character. It also makes a cell with an extra high amperage and this cell is known as the Wizard. For telephone work is offered the Hello cell for which unusual endurance is claimed. For bell work and the cheaper and simpler forms of service the Sun cell is manufactured. In addition to these standard types the factory of the company is capable of turning out cells of any size or shape.

The Installation and Operation of Alternating-Current Generators.—II.

COLLECTOR RINGS.

With small alternators the collector rings are mounted in place on the shaft and connected to the field windings. On large machines, especially those of the engine type where there is no shaft, the rings are shipped separately, and in large machines both the hub and the rings are split so that they can be put in place after the rotor has been mounted in its bearings. See that the collector rings are fixed securely in position so as to run true, and connect the rings to the leads from the field winding, making sure that all contacts are clean and bolted up tight.

With large engine-type alternators and also with some of the larger water-wheel machines the brush holders are supported by a stand bolted to the base or to a bridge fastened to the sole plates. On smaller machines the brush holder studs are supported by the bearing pedestal. See that all insulating bushings and washers on the brush studs are in place and that the studs are bolted up tight; also that the brush holder stand, if any, is firmly bolted to the bed or bridge and that it is properly lined up with the collector rings.

BRUSHES.

The brushes should be carefully fitted to the collector rings first using coarse sand or garnet paper and finishing with fine sand paper. While shaping the brushes hold the paper well down on the rings so as not to wear away the edge of the brush. See that the whole surface of the brush makes contact with the ring and that the finger presses squarely on the brush. The pressure should be adjusted by changing the position of the tension spring on the arm and should be such as to give a good contact on the ring; a greater pressure improves the contact very little and only causes excessive friction loss, wear, and heating of the brushes and rings. Good judgment and careful attention will soon show the best pressure to be used.

BEARINGS.

See that the oil wells are thoroughly cleaned and filled with a good grade of mineral oil; fill up the wells to such height as will insure that the rings carry up oil. See that the oil well covers are in place so that no foreign matter can drop into the bearings. When the machine is first started it is advisable to draw off the oil at the end of each day's run and fill up with fresh oil until it is certain that all fine particles of foreign matter are out of the bearings. The oil drawn off can be filtered and used over again. When a machine is first started, it is advisable to run slowly for an hour and watch the bearings closely before running up to full speed.

WIRING.

In all wiring, special attention must be paid to the mechanical execution of the work and special precautions are necessary with the wiring for high pressure alternators. In running the wires the requirements of the National Board of Fire Underwriters should be observed, and special care should be taken to have all joints secure and thoroughly insulated. All wires should be of sufficient cross section to carry at least 25 per cent overload without over-heating. For wires larger than No. 2 B. & S. it is advisable to use stranded cable, as cable is much easier to run than solid wire.

SHUTTING DOWN.

When machines are operated in parallel and one is to be shut down, first reduce the load by throttling the engine or slacken-

ing the belt. Then open the main switch. Increase the resistance in the field circuit of the alternator to reduce the field current, and then open the field switch.

GENERAL CARE OF THE MACHINE.

On account of not having a commutator, alternators are on the whole much easier to keep in good running order than direct-current machines. At the same time they must be properly attended to. It must be remembered that they frequently generate much higher pressure than direct-current machines and there is all the more necessity for keeping them perfectly clean. No dirt, copper or carbon dust should be allowed to accumulate on or near the windings, and in plants sufficiently large to warrant the expense, it is advisable to install a compressed air system so that all dirt can be blown out of the corners not otherwise easily reached. It is also advisable to give the armature coils and connections a coat of insulating varnish occasionally.

Keep the collector rings lubricated with a small quantity of vaseline applied with a cloth and see that the brushes make good contact with the rings.

Never open the field circuit suddenly while current is flowing, and see that both the main and the field circuit switches are open when the machine is not running.

Never throw machines in parallel when they are out of synchronism; the excessive rush of current throws heavy strains on the engines and generators and may cause considerable damage.

Remember that an alternator is designed for the voltage indicated on the name plate. It must not be expected to give voltages considerably above normal with satisfactory performance of either the exciter or the alternator. Furthermore, the rated current output should not be continuously exceeded.

Check the depth of air-gap between the stator and the rotor now and then, and if it is found to be uneven, realign the machine. This applies particularly to engine-type generators. See that all bolts and nuts are kept tight. Electrical machinery should receive as much attention in this respect as steam engines.

DRYING OUT.

If a machine has been exposed to low temperature, it should not be unpacked until it has reached the same temperature as that of the room, otherwise a film of moisture may form thereon due to condensation. After the alternator has been set up it should be dried out by short-circuiting the armature terminals and running the machine with low field excitation sufficient to circulate in the armature a current about 25 per cent greater than normal full load current. An ammeter should be inserted to indicate the current, and the machine run until it has become thoroughly warmed up and all moisture expelled.

STARTING UP.

In case the alternator does not operate in parallel with other machines the following instructions should be observed:

Bring the alternator and exciter up to speed and make sure that the oil rings are revolving freely. See that all of resistance in both the exciter and the alternator field rheostats is placed in circuit and that both the field circuit and the main switches are open. Cut out the resistance in the exciter field circuit and bring the exciter pressure up to normal. Close the field switch of the alternator and have all resistance in the field circuit so that full voltage will not be generated in the windings. In case the machine is being started for the first time, allow it to run for an hour or two at low voltage and then gradually increase the voltage until it reaches normal; the load can then be thrown on. As the load increases it will be necessary to cut out some resistance in the field circuit in order to maintain the full voltage, and if the load on the alternator is inductive a larger amount of resistance must be cut out than with non-inductive load. On light loads comparatively small field excitation is required and it is advisable to run the exciter at rather low voltage and avoid wasting so much power in the field rheostat, provided the exciter voltage is not made low enough to render the operation unstable or cause sparking at the brushes, and that the exciter is not used for exciting other alternators.

SHUTTING DOWN.

Where a machine is run by itself and is to be shut down, first increase the resistance in the field circuit of the alternator, thus lowering its voltage. Then open the main switch and finally the field circuit switch of the alternator. The alternator field circuit should not be opened when full current is flowing because the high induced e.m.f. caused thereby may be sufficient to break down the field insulation. With most of the larger machines made by the Allis-Chalmers Company a grid resistance is connected to the field switch so that in case the latter

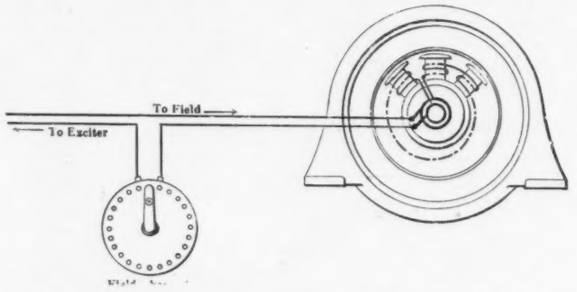


FIG. 8.—DIAGRAM OF EXCITER CONNECTIONS FOR SMALL ALTERNATING-CURRENT GENERATORS.

is opened the resistance is first connected across the field circuit, thus forming a path through which the induced current can flow and prevent any abnormal rise in e.m.f. Fig. 8 shows exciter connections for small machines, and Fig. 9 for larger alternators where a grid discharge resistance is used.

PARALLEL OPERATION.

When two or more alternators are run in parallel there are certain conditions that must be met in order to secure satisfactory operation. These are:

a. The machines must be in synchronism. That is, the frequency must be the same for each, and the e.m.f's of the different machines must be in phase.

b. The e.m.f's must be approximately equal.

c. In order to secure proper division of the load under changes in load conditions the speed regulation of the prime-movers must be alike.

d. To prevent periodic cross currents between machines the

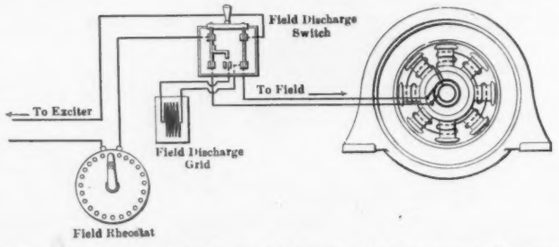


FIG. 9.—EXCITER CONNECTIONS WITH FIELD DISCHARGE RESISTANCE.

variations in angular velocity of the prime-movers must be kept within certain limits. In water wheel or steam turbine driven units the angular velocity is uniform, but with reciprocating engine units there may be trouble due to periodic variation if the engine fly-wheels are not heavy enough.

BELTED ALTERNATORS.

With belted alternators it is very important that the pulleys be proportioned so as to make the speeds of the alternators such that they will give exactly the same frequency; if all the machines have the same number of poles their speeds must be exactly alike. If the pulleys are not of the proper size there will be excessive belt slippage or exchange of cross currents between the machines, thus causing fluctuations in voltage.

ENGINE-DRIVEN ALTERNATORS.

With engine-driven alternators the speed can be varied by adjusting the governor, and there will be no trouble from cross currents provided this angular velocity of the engines does not vary too much, and the engine governors act properly.

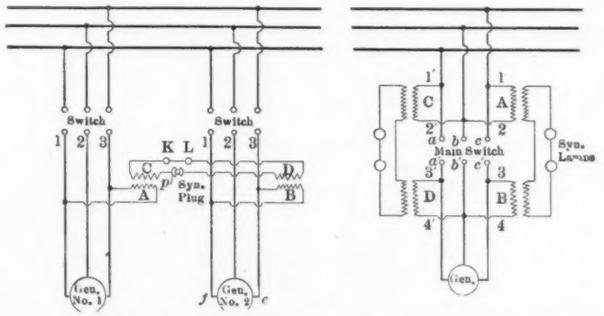
DIVISION OF LOAD.

When two alternators are running in parallel their output (actual power) depends on the amount of power supplied by their prime-movers. For example, suppose two engine-driven machines are running in parallel on a certain load and that each is taking half of the load. When the load increases there is a tendency for the speed to drop slightly, and in order for the engine governors to act and admit more steam there must be a slight drop in speed. Now the two alternators must always run in synchronism, or at the same speed, assuming the number of poles to be alike, and if the drop in speed does not result in an equal increase in the steam admission of each engine one alternator will be supplied with more power than the other and the load will become unequally divided. Changing the field excitation of the lightly loaded machine will not remedy matters (as with direct-current generators where the generators do not have to run in synchronism and have independent speeds). The only effect of changing the field excitation is to make a wattless current circulate between the two alternators, the actual amount of power supplied by each remaining the same. The only way to increase the steam admission is by adjusting the engine governor, and to secure equal division of load under all conditions the change in speed for a given change in load must be alike for each engine. When two or more alternators are run in parallel it is advisable to have an indicating wattmeter on each machine, so that the actual load will be indicated. In case wattmeters are not provided the load on each should be adjusted so that the sum of the currents as indicated by the machine ammeters will be a minimum for a given total current supplied to the line. If the sum of the machine currents is much in excess of the line current it shows that a wattless current is circulating between the machines.

SYNCHRONIZING.

The condition of synchronism is usually indicated either by incandescent lamps, or by a synchronism indicator or synchroscope, the latter now being used in most large installations. A synchroscope gives more accurate indications than lamps and has the additional advantage of showing whether the incoming machine is coming into or going out of phase and how much it is out of phase.

Fig. 10 shows diagrammatically the connections for the synchronizing lamps. Two small transformers, *A* and *B*, have their



FIGS. 10 AND 11.—CONNECTIONS FOR SYNCHRONIZING LAMPS.

primaries connected to the same phase of each generator. The secondaries, *C* and *D*, are connected in series through a plug or switch, *P*, and lamps *K* and *L*. Assuming that corresponding terminals of the primaries are connected to corresponding lines on each machine and that the two transformers are alike in every particular, corresponding secondary terminals will, at any given instant, have the same polarity when the two machines are in phase. When plug, *p*, is inserted, secondary terminals of opposite polarity are connected together; hence the two secondary e.m.f's. are in series and aid each other in forcing current through lamps, *K* and *L*, which are, therefore, bright at synchronism. It may happen that the transformers are not wound exactly alike or that the connections have become confused; it is always advisable, therefore, to test the connections to make sure whether the lamps are light or dark at synchronism. To test the connections in Fig. 10 disconnect *B* from generator No. 2 and transfer the connections, without changing their relative position, to lines 1 and 3 of generator No. 1; *A* and *B* will then be connected to the same lines, and if the lamps are bright, they will also be bright at synchronism where *B* is connected to generator No. 2, as shown. If dark lamps are preferred, either the primary or secondary connections of one transformer may be reversed.

Another method of testing the connections is to leave the transformer connections as they are and disconnect the main leads, *e* and *f*, on generator No. 2. Both of the main generator switches should then be closed, thus connecting transformers, *A* and *B*, to generator No. 1. In synchronizing it is preferable to have the lamps bright rather than dark.

When a polyphase alternator is first connected up it is important to see that all of its phases correspond with those of the bus-bars; if one phase only of a three-phase machine is correct, it does not follow that the other two are correct also. Two of the phases should be tested at the same time by using a pair of auxiliary transformers in addition to the regular synchronizing transformers, shown as *A* and *B* in Fig. 11. Transformer, *A*, is connected to the bus-bars and *B* to the generator. A second pair of transformers, *C* and *D*, is connected to one of the other phases, the connections in each case being such that the lamps are bright at synchronism. The connections should be tested as described above to make sure that the polarity of the transformers is correct. With the main switch open and with the generator running at full voltage, both sets of synchronizing lamps should pulsate together. If they do not do so the leads from the generator are incorrectly connected to the generator terminals and should be interchanged so as to make the lamps pulsate together. After this test has been made, to insure that terminals, *a*, *b*, *c*, connected to the bus-bars correspond to *a'*, *b'*, *c'*, connected to the generator, the temporary transformers, *C* and *D*, can be removed.

BELTED MACHINES.

When a belted alternator is to be thrown in parallel with another machine, first bring the incoming generator up to speed and adjust the voltage until it is approximately the same as that of the bus-bars. Adjust the speed until the beats of the synchronizing lamps become very slow, say one beat in two or three seconds, or until the pointer of the synchroscope is moving very slowly. Close the main switch when the lamps indicate synchronism (lamps light or dark depending on the connections), or when the pointer of the synchroscope is over the central point or slightly ahead of it. Adjust the field excitation and see that the alternator is supplied with enough power to make it carry its share of the load. In case several belted alternators are driven from a common line shaft, the belt of the incoming machine should be slackened, thus introducing enough slip to allow the machine to be synchronized. After the alternator is in step, the belt can be tightened and the load gradually applied.

ENGINE-DRIVEN MACHINES.

With engine-driven alternators the incoming machine should be given only a small amount of steam until after it is synchronized. The load can then be taken up by admitting more steam. In large plants the engine governor is usually arranged so that it can be controlled electrically from the switchboard and the steam admission varied as desired. If the governor cannot be so controlled the steam admission can be regulated at the throttle. Water-wheel governors are also frequently provided with an electrical control device; if not, the gate opening must be controlled by hand to synchronize the machine and adjust the load.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—New business in many sections of the country was restricted by severe storms, which also retarded the delivery of old orders. The additional traffic difficulty made freight movement most unsatisfactory, and in some cases the light receipts of fuel and foodstuffs caused hardship. Commodity prices advanced as a rule. Jobbers report a good demand for spring delivery, especially in dry goods, but business is retarded by slow shipments from the mills and collections are only fair. Manufacturing plants operate at full capacity in the leading industries, although there are complaints of fuel scarcity. Real estate transactions and building permits promise much structural activity later in the season, sustaining prices of materials. Iron buying has become rather quieter, with far-off deliveries easing. Money is easier, commercial paper is more fully taken, and the security, grain and cotton markets are all higher. Better export buying is noted in all grains. In the steel trades the inflow of business to mills and distributors continues at high tension. The week's bookings by the United States Steel Corporation ran slightly above the daily average of 35,000 tons—almost the double of the daily average for the corresponding week two years ago. Like conditions exist with the other important producers—all being sold to full capacities for months ahead. Export trade is increasing in wire and wire products, agricultural implements, sewing machines, typewriters, air compressors and mining machinery. Orders for steel rails are moderate, trolley lines figuring as the largest purchasers, while the placing of some large orders has been deferred, owing to money market conditions. Specifications for structural materials are coming along freely, and conditions in all finished lines are satisfactory. There were fewer failures in January than in any corresponding month for fifteen years past, but liabilities were the largest for any January since 1897. Every section of the country reports fewer failures than a year ago, except the territories. The failures for the week ending February 7, according to *Bradstreet's*, numbered 198 against 211 in the previous week, and 204 in the like week of 1906. The domestic copper markets closed with a number of heavy tonnages sold by producers for June shipment. A Chicago corporation brought 3,000,000 lbs. of electrolytic for June at 25c.; a Connecticut consumer bought 1,500,000 lbs. at the same price for June, and a specification for London was closed for April, May and June at 25⅛c. for the earlier shipments and 25c. for June. For a Pittsburg interest an order for 850,000 lbs. was entered at 25¼c. for May electrolytic. Prime lake is in urgent request for large tonnage.

JOHNS-MANVILLE CONVENTION.—During the past week the various branch managers and department managers of the H. W. Johns-Manville Company held their annual convention at the headquarters of the company, 100 William Street, New York. This company has a world-wide reputation as being the largest manufacturers of asbestos, magnesia and electrical products in the United States, if not in the world, having factories at Brooklyn, Milwaukee, West Milwaukee and Hartford, Conn., and branch offices and warerooms in the following cities: Milwaukee, Chicago, Boston, Philadelphia, St. Louis, Pittsburg, Cleveland, San Francisco, Los Angeles, Seattle, Kansas City, Minneapolis, New Orleans, Dallas and Buffalo. Representatives from the various branches and factories were present, and the meeting was not only profitable, but interesting to everyone present. As a fitting finale, the convention wound up with a banquet at the Waldorf-Astoria.

LOS ANGELES (CAL.) ELECTRICAL POWER.—The Edison Electric Company, of Los Angeles, has finished a 60,000-volt transmission line from its 25,000-hp hydro-electric station on the Kern River, a distance of 128 miles from Los Angeles, consisting of six cables carried on steel towers from 30 to 75 ft. high. The power house, which is built of concrete with iron roof, is equipped with five three-phase generators, each of 3,200 kw, built by the Allis-Chalmers Company, Milwaukee, direct-connected to hydraulic turbines. The canal is about twelve miles long with a carrying capacity of 700 cu. ft. per second and a head of 270 ft. Five sets of step-up transformers are used, each 2,250 kw. The transformer station in Los Angeles has four compartments, each containing three transformers of 750 kw each. The power thus transmitted is used in the operation of street railway cars over the Los Angeles City & Interurban lines.

SOUTHERN POWER COMPANY.—The water power developments of the Southern Power Company in the Carolinas have become famous as being among the most extensive and most carefully executed enterprises of the kind in the country. The company's mains will, when their developments are complete, cover many hundreds of square miles of the "Piedmont Region" with a network of transmission lines for furnishing power for cotton mills and light for the towns and cities of the district. The City of Statesville, N. C., has recently purchased three 500-kw Allis-Chalmers transformers for use on the Southern Power Company's circuits which supply the city at primary voltages of 40,000, 20,000 and 10,000 volts. The secondary voltages for use in Statesville will be 2,300 and 575 volts.

GREEN ECONOMIZER FACTORY.—The Berlin Construction Company, Berlin, Conn., has received a contract for building an extension to the fan shop of the Green Fuel Economizer Company, at Matteawan, N. Y. The latter company has recently done a heavy business in fans, and this addition will enable it to more than double its present output. A shop has also been put up exclusively for manufacturing the new patent Green steam and hot-water heating coil. The pressure of business in these lines and also in the manufacture of fuel economizers, has compelled the Green company to acquire for building purposes several acres of land adjacent to the present property.

A STRANGE METHOD OF SYNCHRONIZING.—A story of remarkable ease in synchronizing alternators is being told of two 300-kilo-volt-amp. machines at the Kingsland shops of the D. L. & W. Railroad. The engineer in charge on being asked if he had any trouble in synchronizing said: "Why, I stand alongside of one of the machines and look through the rotor towards the other. When the spokes get in line, I just shout to Jimmy over at the switchboard to throw in the switch.' Upon inquiry it developed that the machines which showed such a desire to run in parallel were Crocker-Wheeler 300-kw, 60-cycle, 32-pole engine type alternators, of their standard solid pole construction.

N. W. HALSEY & CO., brokers, of New York City and Chicago, who have handled a large mass of electrical securities, are putting up a fine building in San Francisco that is intended to be fireproof and earthquake-proof. It is also to be panic-proof. The building, as planned, will be of Tudor-Gothic design, four stories in height and will occupy a lot 45x124 feet, at Nos. 412 and 414 California street, immediately joining on the west the new building which the Bank of California is about to erect. According to the plans, the glass in the windows will be welded over steel wire and all the door cases and window frames will be of metal to simulate bronze.

STURTEVANT GENERATING SETS.—Sales of Sturtevan generating sets are reported as follows: Richard Borden Manufacturing Company, Fall River, Mass.; Mallory Steamship Company, Newport News, Va.; Faultless Manufacturing Company, St. Charles, Ill.; Eastern Brass & Machine Works, Easton, Pa.; steamship *Princess Anne;* Roughsedge & Ramsey, Prince Albert, Sask., Can., and Bowker Construction Company, New York City, for ocean tug *Robert Rogers.*

NATIONAL ACME PLANT.—The National Acme Manufacturing Company, of Cleveland, O., has let contracts for the erection of an addition to its present plant. The new building will be of brick and steel construction, approximately 400 ft. long and six stories high. It is hoped to have the addition ready for occupancy July 1.

POWER IN NEVADA.—A special dispatch from Rhyolite, Nev., of February 4, says that the Nevada & California Light & Power Company will be in operation in Rhyolite within 90 days. Goldfield, Manhattan and Tonopah already are supplied with light and power by this company. C. Q. Poole of this company is now in Rhyolite arranging for the opening of offices, and ground has been broken for the sub-station on Bonanza Mountain that will distribute the electrical energy that comes 130 miles across country from the Owens River country. There are three power plants, either running or in process of building, and 20,000 hp will be at the disposal of the company within the next 30 days. Connections with the Rhyolite line will be made 50 miles west of Goldfield, at Palmetto, Nev., and the Rhyolite branch which is now being built will be 75 miles long. Construction of the line is being pushed from both ends. The poles and wire for use out of Rhyolite have been freighted from Los Angeles and Salt Lake, while work on the northern end has been pushed a distance of more than 20 miles. The sub-station which is to be built on Bonanza Mountain will be in operation in April, and 4,000 hp will be distributed through the Bullfrog and Greenwater districts at 50,000 volts. The company is backed by T. B. Stickney and C. M. Hobbs, of Denver.

POWER IN MEXICO.—Advices from the City of Mexico state that a contract has been signed with S. P. Applewhite of that city for the development of electric power on the Rio Grande, district of Cuicatlin, state of Oaxaca. Mr. Applewhite has the right to transmit electrical energy to any point he may find desirable. It is his intention to supply power and electric lighting to the City of Oaxaca and to the different mining camps in that region, principally in the district of Taviche, where power at the present time is badly needed. It is reported that the development of the mines in that district, although progressing rapidly, are greatly retarded owing to the lack of adequate power. Wood is very scarce and some of the mines are at present using coal to run their steam engines, costing in the neighborhood of $31 per ton. The introduction of electric power will be the salvation of the situation in that locality. It is proposed that development of the project will be started at a very early date. The concession carries with it the usual franchises, such as the free importation of all materials, machinery, etc., exemption from taxation, the free use of government lands, etc.

COST OF MATERIALS.—Owing to the increased cost of of all kinds of material going into telephone plants and the missuse of the instruments, the managers of the Cleveland local companies believe that either an advance in rates will ultimately have to be made or the charges fixed by message, rather than by the month or year. The Cuyahoga Telephone Company has a good supply of copper and has bought nothing since it advanced beyond 20 cents a pound. Manager C. Y. McVey says that iron wire for insulated drops from the street cables to homes has been used and has resulted in quite a saving. Manager Yensen, of the Cleveland Telephone Company, feels that charging by the message would be the proper way to get at the matter. This, he thinks, would do away with all improper use of the service and people would take advantage of it only when needed, rather than at all times their whims dictate. The high interest rate on money is cutting quite a figure, too, as most of the companies must finance their improvements and extensions.

HUDSON TUNNEL CONTRACTS.—Advices from Pittsburg state that five local concerns have been awarded contracts which will total more than $2,000,000 by the Hudson companies, the subsidiary concern which is building the Pennsylvania Railroad tunnel under the North River and the New York terminal. The Pressed Steel Car Company has begun work on the first of 250 all-steel cars for the underground service. The Carnegie Steel Company has secured an order for the steel rails to be used in the tunnel and terminals, while the American Bridge Company will supply and erect the structural iron work for the tunnel and the Fulton and Hudson office building at the terminal. The Westinghouse Company has been awarded the contract for the motor and air brake equipment of the cars, and the Oliver Iron & Steel Company is making the bolts with which the seams of the tunnel are connected. Eight cars to a train will be run during the rush hours, each car being equipped with separate motors, but all working under direct control of one motorman.

ALLIS-CHALMERS AIR BRAKES.—A carload of air brakes recently left the West Allis Works of the Allis-Chalmers Company, eastward bound for foreign shipment. The air brake department has up to the present time, been actively engaged in supplying the regular demands of domestic trade. The present shipment to a foreign country therefore marks a step forward for this additional line of production of the company. The impetus of the past few years given to the building and operation of interurban and electric railways everywhere, has greatly increased the demand in this country and abroad for brakes of this description. Over 80 per cent of all the electric railways using power brakes of any kind, are equipped, it is said, with Christensen brakes, now manufactured by the Allis-Chalmers Company.

MECHANICAL DRAFT.—The application of mechanical draft in place of a chimney continues to increase. Recent orders for such equipments are reported by the B. F. Sturtevant Co., of Boston, Mass., for Jacob Ruppert Brewery, New York City; Wellman-Seaver-Morgan Co., Cleveland, Ohio; Leominster Button Co., Leominster, Mass.; Saquoit Silk Mfg. Co., Philadelphia, Pa.; John L. Roper Lumber Co., Oriental, N. C.; Barber Asphalt Paving Co., Nyack, N. Y.; Fels & Co., Philadelphia, Pa.; Worcester Gas Light Co., Worcester, Mass.; Crane Co., New York City; Michigan Copper Mining Co., Keweenaw Bay, Mich.

INCANDESCENT LAMPS.—The General Electric Company is reported to have bought the old plant of the Toledo Molding Company, Toledo, O., near the Libbey Glass Works, for the purpose of establishing there a factory for the manufacture of incandescent lamps. The ground is 300 by 400 ft. and the three-story building is 75 by 175 ft. A rumor is current at Niles, O., that the National Electric Light Company has bought the plant and good will of the Banner Electric Company, at a good price, and that the old force and staff will be retained, with Mr. N. L. Morris as manager.

PORCELAIN FACTORY FIRE.—The factory of the Imperial Porcelain Company, at Trenton, N. J., was destroyed by fire on February 2. The concern is one of the largest manufacturers of electrical porcelain specialties in the country. The plant is to be rebuilt immediately. The loss is understood to be practically covered by the insurance. Messrs. F. A. Duggan and B. B. Dinsmore are at the head of the enterprise.

TROLLEYS IN SPAIN.—A concession is to be given for the construction and working of electric tramways in Barcelona, Spain, from the Rambla de Cataluma via the Carretera Consejo de Ciento to Hostafranche for 60 years or less. Address Dirección de obras públicas, Ministerio de Fomento, Madrid, Spain.

ELECTRIC CRANES.—An order for 10 three-motor type cranes, ranging from 5 to 25 tons, has been placed with the Cleveland Crane & Car Company, Cleveland, O., for the new works of the Empire Bridge Company, at Elmira, N. Y.

LIGHTING IN FINLAND.—According to the *Mercator* at Helsingfors, Finland, the towns of Lovisa, Nyslott and Nystad intend to introduce electric-lighting systems, and in the spring will invite tenders from electrical firms.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was firm and more active at a substantial improvement in prices. Rumor of further borrowings by railroad companies were circulated, but had little effect. Industrial stocks were quiet, and the United States Steel issues did not fully respond to the improvement in other parts of the list. The week closed with a reaction. The week's statements of earnings published by the Reading, the Pennsylvania and the Grand Trunk, showing decreases in net for December, confirm the predictions made over a month ago that the railroads would suffer from congestion of freight and car shortage. It will be two weeks or more before the full returns are available. With the exception of New York & New Jersey Telephone all the electric securities are higher than a week ago, the range of advances being from ½-point to 2¾ points, the latter being General Electric. New York & New Jersey Telephone declined 5¾ on the week's trading. The curb market was a little more active during the week, recovering in sympathy with the exchange list. Following are the closing quotations of Feb. 11:

NEW YORK

	Feb. 5	Feb. 11		Feb. 5	Feb. 11
Allis-Chalmers Co.	14¼	15¼	General Electric	157	160½
Allis-Chalmers Co. pfd.	36	38⅜	Hudson River Tel.	...	...
American Dist. Tel.	...	...	Interborough Met. Com.	35⅛	35
American Locomotive	71⅛	71⅝	Interborough Met. pfd.	71¼	71
American Locomotive pfd.	110	111	Mackay Cos.	...	...
American Tel. & Cable	83	80	Mackay Cos. pfd.	...	...
American Tel & Tel.	...	...	Marconi Tel.	...	...
Brooklyn Rapid Transit	73⅛	74⅛	Metropolitan St. Ry.	...	...
Electric Boat	31	32	N. Y. & N. J. Tel.	...	...
Electric Boat pfd.	73	73	Western Union Tel.	82⅜	83
Electric Vehicle	...	...	Westinghouse com.	150	150
Electric Vehicle pfd	...	...	Westinghouse pfd.	...	...

BOSTON

	Feb. 5	Feb. 11		Feb. 5	Feb. 11
American Tel & Tel.	129	128½	Mass. Elec. Ry. pfd	69	69
Cumberland Telephone	...	111	Mexican Telephone	...	4⅛
Edison Elec. Illum.	228	225	New England Telephone	121	124
General Electric	...	...	Western Tel. & Tel.	...	...
Mass. Elec. Ry.	19	19⅛	Western Tel. & Tel. pfd.	...	...

PHILADELPHIA

	Feb. 5	Feb. 11		Feb. 5	Feb. 11
American Railways	60⅛	60⅝	Phila. Electric	7⅞	8
Elec. Co. of America	10⅜	10⅛	Phila. Rapid Trans	20⅛	21⅛
Elec. Storage Battery	63	64	Phila. Traction	...	...
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Feb. 5	Feb. 11		Feb. 5	Feb. 11
Chicago City Ry.	150	150	National Carbon	78	...
Chicago Edison	140	...	National Carbon pfd.	117	...
Chicago Subway	30⅛	...	Union Traction	...	...
Chicago Tel. Co.	...	...	Union Traction pfd.	...	...
Metropolitan Elev com.	20⅛	26			

*Ex-dividend

PNEUMATIC TOOL EARNINGS.—The annual report of the Chicago Pneumatic Tool Company shows profits of $1,001,550 for the year ended December 31, 1906. After the deduction of $128,081 for depreciation and renewals and $21,999 for the developing and perfecting of new tools, there remained $851,468, out of which bond interest of $115,000, a sinking fund installment of $50,000, and a 4 per cent dividend aggregating $244,351 were paid, leaving a surplus for the year of $442,117, which brings the total surplus up to $878,409. The company has acquired the Consolidated Pneumatic Tool Company, Ltd., of London, and has organized the Internationale Pressluft & Elektricitaets-Gesellschaft, Berlin, and has bought the Canadian Pneumatic Tool Company, Ltd., Montreal. All of these organizations, says the report, show during the year increased volume of business and substantial gains in assets, with the result that the company has benefited in additional facilities for marketing its output, with resulting increased profits. In connection with the acquirement of the business of the Philadelphia Pneumatic Tool Company, of Philadelphia, and the organization and extension of the foreign companies, it was thought desirable to borrow temporarily $195,000, which is included in the item "Bills Payable," amounting to $247,499.94. The amount so borrowed has been more than offset, the report asserts, by the additional assets acquired. Additions to plants have been made during the year and development work completed has exceeded that of the previous year. Mention is made of the fact that of the authorized issue of $2,500,000 bonds, $200,000 are still in the treasury, and $293,000 have been retired for sinking fund purposes, leaving outstanding $2,007,000. The excess current assets on December 31, 1906, $1,542,075.99, show an increase of more than $883,000 since the company was organized five years ago.

VERMONT POWER DEAL.—It is reported from Montpelier, Vt., that a sale has been made of the J. S. Viles Lighting & Power Co. to the Consolidated Lighting Company, whereby the latter concern becomes one of the largest of its kind in New England. The price paid is said to be over $300,000. By the transaction the Consolidated company acquires the plant at Middlesex Narrows and all the lighting and power contracts in Montpelier, Middlesex, Barre, Williamstown, East Barre, South Barre, Graniteville and Waterbury. The combined power of the two plants will give the Consolidated company 6,600 water horsepower and 3,500 steam horsepower, or a total of 10,100 hp. The officers of the new company, it is announced, will be the same as those of the Consolidated: President, W. F. Davidson, Port Huron, Mich.; vice-president, John C. Tomlinson, of New York; treasurer, A. D. Bennett, of New York; secretary and general manager, J. E. Davidson, of Montpelier.

PACIFIC TELEPHONE.—It is announced from Boston that the syndicate of California bankers which purchased recently $10,000,000 5 per cent 30-year first mortgage bonds of the Pacific Telephone & Telegraph Company has already sold more than the first installment of 25 per cent of the bonds which came due about two weeks ago. Nearly $3,000,000 of the bonds have been placed, mostly in California, where they are tax exempt and where the price of 102½, a 4.85 per cent income basis, renders them the equivalent of a 5½ per cent income non-exempt bond. The syndicate has about thirty months in which to take up the full $10,000,000 bonds. The Eastern selling agents for the syndicate are N. W. Halsey & Co., but in the present condition of the bond market, flooded as it is with other telephone issues, it has not been considered wise to make any Eastern offering of the bonds. Their natural market is in California and the bulk of them will undoubtedly be placed there in spite of the disaster in San Francisco.

MISSOURI BELL TELEPHONE.—The Bell Telephone Company of Missouri will offer to stockholders of record February 26 the right to subscribe at par to $2,028,000 new stock in the ratio of three shares of new stock for every ten shares of present stock. The rights are estimated at $10 per share. The outstanding stock is $6,391,250, on which 8 per cent is being paid. The company closed its fiscal year December 31, 1906, with a total of 42,843 stations, an increase of 12,656 during the year. The company expended $1,800,000 in new construction in 1906, a portion of this amount going into enlargements of cable conduits. The net earnings of about $500,000 were distributed in 8 per cent dividends on the $6,391,250 stock.

DIVIDENDS.—The directors of the Niles-Bement-Pond Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable February 15. They have also declared the regular semi-annual dividend of 3 per cent on the common stock, payable in two installments—1½ per cent March 20 and 1½ per cent, payable June 20. The directors of the Pratt & Whitney Company have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable February 15. The directors of the Grand Rapids Railway Company have declared a quarterly dividend of 1 per cent on the common stock, payable March 1. The Columbus (O.) Railway has declared a regular quarterly dividend of 1¼ per cent on the common stock.

OREGON MINING POWER.—The Condor Water & Power Company has been obliged to double its equipment. The central plant of the company is at Gold Bay, on Rogue River, whence it distributes electrical energy to all the districts of Josephine and Jackson counties. The company is now placing at its various distributing points step-up transformers which will raise the line voltage from 20,000 to 40,000 volts. When the new transformers are in and other improvements now under way are completed, the Condor company enterprise will be second to none as a mining power supply on the Pacific Coast. Its power lines have been strung to every important mine or mining district within a radius of 50 miles of Gold Bay.

U. S. INDEPENDENT TELEPHONE.—The United States Independent Telephone Company, of Rochester, has announced that an agreement has been reached between the holders of $6,000,000 of the company's bonds and a trust company, to take over the entire bond issue of $13,316,000 of the company at 35, $4,782,200 of its stock at 5 and the deferred stock used to purchase the New York Independent Telephone Company's franchise. Reference to this transaction has already been made in these pages.

WESTERN ELECTRIC EARNINGS.—The Western Electric Company in its annual report gives its gross earnings in 1906 as the gigantic sum of $69,245,331, against $44,145,753 in the preceding year, an increase of 56.8 per cent. This enormous business was due to Bell telephone expansion chiefly. The total number of employees was 26,938 as compared with 19,704 in the previous year. The gross earnings in 1904 were $32,453,980.

BOSTON EDISON STOCK.—At an auction in Boston, 60 shares of Boston Edison Electric stock were placed on sale by authority of the Board of Gas and Electric Light Commissioners. Five shares were sold at $225, five at $220, and fifty shares at $216½.

HUDSON RIVER POWER.—The Hudson River Power Company earned $894,227 last year, an increase of $155,839 over 1905. The earnings for December were $89,645.

GENERAL NEWS.

Construction News.

GOODWATER, ALA.—The authorities of Goodwater are installing an electric light plant at an expense of about $1,500, the power of Matchett Creek being utilized.

GREENVILLE, ALA.—The Henderson Light & Power Company is planning to establish a day service after April. C. C. Henderson is president and manager.

MARION, ALA.—The Marion Light & Power Company is considering the question of establishing a day service in April or May. T. D. Kemp is manager.

OPELIKA, ALA.—The City Council has granted a franchise to H. L. McKee, of Troy, for an electric street railway for a term of 30 years.

DOUGLAS, ARIZ.—The Douglas Improvement Company is now installing a 325-kw, alternating-current generator direct connected to an Allis-Chalmers vertical cross-compound engine. James G. Cowan is manager.

HOPE, ARK.—The managers of the city water and electric light plant are considering the question of installing another dynamo in the plant and establishing a day service. Charles M. Richards is superintendent.

AUBURN, CAL.—W. F. Bryce and associates, of Los Angeles, have purchased the Belleville mine, near Ohir. The new owners are making arrangements to use electricity for operating the mines, and are also said to be contemplating building an electric railway from the mines to Auburn.

CHICO, CAL.—Plans and specifications are being prepared for the erection of a large station at Oroville and Marysville Junction, which will be used as a passenger depot, express office and power sub-station.

FRESNO, CAL.—The San Joaquin Light & Power Company is contemplating the erection of numerous suburban power lines. A. G. W. Wishon is manager.

LEMOORE, CAL.—H. C. Watson has applied to the Board of Trustees for a franchise to lay conduits and string electric wires for the transmission of electricity in this city.

LOYALTON, CAL.—The Loyalton Electric Light Company is contemplating changing from steam to water power this year. R. W. Bender is manager.

SACRAMENTO, CAL.—A contract has been placed with the Hawk, Hawley & Carley Company by the Sacramento Gas & Electric Company for the immediate construction of an extension of the road from Highland Park to Curtis Oaks.

SAN FRANCISCO, CAL.—A new power company is entering the field under the name of the California-Nevada Electric Power Company, which has been incorporated with a capital stock of $10,000,000. The company plans to build and operate plants for manufacturing, transmitting and supplying electricity in California and Nevada. The directors are R. E. Maynard, of Los Angeles; F. G. Baum, of Berkeley; F. V. Keesling, of San Francisco; C. R. Leevers, of Reno, and O. K. Grau, of this city.

SAN JACINTO, CAL.—The owners of the electric lighting plant are considering the establishment of a 24-hour service, and will change the rates of electricity from flat to meter rate. C. E. Chambers is manager.

STOCKTON, CAL.—The American River Electric Company is to erect a large steam generating plant in this city in the immediate future as an auxiliary to its large hydro-electric plant on the American River. The plant will consist of a 3,000-hp Curtis steam turbine direct connected to generators. It will cost nearly $250,000.

VACAVILLE, CAL.—The Vacaville Water & Light Company is contemplating the erection of one and one-half miles of pole line, 6,600 volts. W. Z. McBride is manager.

VENTURA, CAL.—The Ventura Water, Light & Power Company is at present erecting a 60-mile, 33,000-volt, three-phase transmission line connecting plants and tapping Edison Company's power transmission lines, building four sub-stations and wiring the towns of Montalio, Saticoy, Fillmore and Piru; also installing a 350-kw, tandem-compound Allis-Chalmers engine direct connected to a 2,200-volt, three-phase, 50-cycle Bullock alternator. Two Babcock & Wilcox boilers and complete condensing plant are being installed at Oxnard; also motor generator and engine driven exciter units in same station. The company is also developing 500-hp water power in Ventura and will install a turbine connected to three-phase generator, and will change its system from 60 to 50 cycles. In addition to the transmission line above the company is building a 10,000-volt line from Oxnard to Camarillo, a distance of 10 miles, from Ventura to Saticoy, 9 miles, and from Ventura to Montalio, 4 miles. James E. Barker is superintendent.

CANON CITY, COL.—The City Council has awarded a franchise to Frank D. Heath and associates, granting rights of way for the construction and operation of an electric railway in Canon City to the top of the Royal Gorge, and to the City Park. About twelve miles of road will be constructed to the Royal Gorge and ten miles within the city limits. The enterprise will entail an expenditure of approximately $400,000.

COLORADO, COL.—Ordinances providing for submitting to the vote of the people the question of authorizing the Council to erect a municipal light plant in this city and also for submitting the question of issuing $30,000 in bonds for the construction of the said plant has been introduced and ordered printed.

DURANGO, COL.—Preliminary plans have been prepared for the construction of the Durango & Pine River Electric Railroad, which is to be about 30 miles long.

LONGMONT, COL.—A proposition has been submitted to Council, whereby a new plant can be installed by capitalists who will be willing to sell same to city at any time.

PAGOSA SPRINGS, COL.—The Pagosa Springs Electric Light & Power Company is contemplating the installation of water power, either pipe line or ditch. E. M. Hampton is manager.

STERLING, COL.—The Sterling Public Service Company is contemplating the installation of a 150-hp compound engine and a ten-ton ice plant. Fred. McClain is superintendent.

BRIDGEPORT, CONN.—The New York, New Haven & Hartford Railroad Company has virtually decided to construct a power plant in this city, similar in plan and size to the one at Cos Cob, for the electrification of the main line, in the south end of the freight yard convenient to the coal station. The plan is to bulkhead its property inside the harbor lines and make a score of acres of new ground. The improvements planned will cost more than $500,000.

DANBURY, CONN.—The Danbury & Bethel Gas and Electric Light Company has placed an order with the General Electric Company, calling for a 1,000-hp steam turbo-generator set, complete with all necessary appliances, switchboard panels, etc. Boilers of sufficient capacity to take care of this set have also been ordered. It is expected to have the new equipment installed and in running order within three months. This enlargement has been made necessary by the large increase of the business in the electrical department, due principally to the sale of electricity for power purposes in the various factories and shops in Danbury, also to the demand made by the Bethel manufacturers for electric energy for power purposes. The company is now constructing a three-phase line to Bethel, and expects to have the service ready for its new customers, both for power and lighting, within a few weeks. A proposition is being prepared by the company to furnish the borough of Bethel with electricity for illumination of its streets and highways.

HARTFORD, CONN.—At the annual meeting of the Hartford Electric Light Company, which was held Tuesday, February 12, the stockholders voted on a proposed increase of stock from $1,800,000 to $2,100,000. It is understood that the new capital will be used in part for the retirement of bonds and in part for important construction work in putting under ground all the wires in the section bounded by Farmington and Asylum Avenues and Woodland Street.

TORRINGTON, CONN.—At the annual meeting of the Torrington Electric Light Company this week it was voted to increase the capital stock from $200,000 to $300,000.

WASHINGTON, D. C.—Sealed bids will be received at the office of the Building Committee of the U. S. Department of Agriculture, Washington, D. C., until March 12, for the construction of the power house for the United States Department of Agriculture, Washington, D. C., in accordance with the drawings and specifications, copies of which may be obtained at the Office of the Building Committee, United States Department of Agriculture. All applications must be accompanied by a certified check for $25, made payable to the Disbursing Clerk of the Department of Agriculture, which checks will be retained until the return of the drawings and specifications. B. T. Galloway is chairman.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the Building Committee U. S. Department of Agriculture, Washington, D. C., until March 12, for the power plant equipment of the new buildings for the United States Department of Agriculture, Washington, D. C., in accordance with the drawings and specifications, copies of which may be obtained at the Office of the Building Committee, United States Department of Agriculture. All applications must be accompanied by a certified check for $100, made payable to the Disbursing Clerk of the Department of Agriculture, which checks will be retained until the return of the drawings and specifications. B. T. Golloway is chairman.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Feb. 26, to furnish at the navy yards, etc., Portsmouth, N. H.; Boston, Mass.;

Newport, R. I.; New York, N. Y.; League Island, Pa.; Annapolis, Md.; Washington, D. C.; and Norfolk, Va., a quantity of naval supplies as follows: Schedule 402—arc lamps, etc. Schedule 405—Conductor, resistance coils, conduit fittings, etc. Also until March 12 to furnish at the navy yards, Mare Island, Cal., and Puget Sound, Wash., a quantity of naval supplies as follows: Schedule 411—transformer, attachment for hoisting engine, etc. Schedule 412—pea rock tiling, electrical supplies, rotary blower, etc. Application for proposals should designate the schedule desired by number. E. B. Rogers, Paymaster General, U. S. A.

JACKSONVILLE, FLA.—The Board of Bond Trustees on Feb. 4 awarded the contract for two boilers for the city electric light plant to the Babcock & Wilcox Company, of New York, N. Y., for $15,679.

TAMPA, FLA.—The Tampa Electric Company is contemplating extending its lines to West Tampa, for which franchises have been granted. George W. Wells is manager.

AMERICUS, GA.—A franchise has been granted to the Leroy Davison Street Railway Company to operate an electric railway in this place. W. A. Dobson is manager.

CEDARTOWN, GA.—The question of duplicating the present engine and dynamo in the municipal electric light plant is being considered. W. D. Ivey is superintendent.

WAYNESBORO, GA.—The town has sold $60,000 in water and electric bonds to the Robinson-Humphrey Company, of Atlanta, and has taken over the city lighting plant.

WEISER, IDAHO.—The installation of a direct connected or belted set is contemplated for the municipal electric lighting plant. W. J. Morehead is superintendent.

ASSUMPTION, ILL.—The Council has granted a franchise to the Springfield & Southeastern Traction Company.

FREEPORT, ILL.—At the annual meeting of the stockholders of the Freeport Railway, Light & Power Company, on January 23, it was decided to expend $35,000 or $40,000 in placing an entire new plant at Brown's mill, to be used in creating a lighting and power service; it was also decided to arrange for a general betterment of the service in this city, the street lighting circuit is to be enlarged, the street railway to be extended in different directions and more equipment added to the city power plant. A. J. Goddard is president and general manager.

MORGAN PARK, ILL.—The street lighting system of the municipal electric light plant will soon be equipped with enclosed arc lamps. Charles Stemm is superintendent.

NOKOMOS, ILL.—The Nokomos Electric Light & Power Company is contemplating changing the street lighting system from open direct-current lamps to enclosed alternating-current arc lamps. W. H. Casselberry is manager.

PARIS, ILL.—The street lighting system of the municipal electric lighting plant is being changed to luminous arc lamps.

ROCHELLE, ILL.—Extensive additions and improvements are being made to the municipal electric lighting plant at a cost of $25,000. A new power house is being built, two new boilers of 150 hp each added to the plant and a brick smoke stack 100 ft. high is now under construction. O. Rhodes is superintendent.

SPRINGFIELD, ILL.—John Brinkerhoff and associates have applied to the City Council for a franchise to construct and operate an electric lighting plant in this city.

URBANA, ILL.—The Urbana Light, Heat & Power Company will install in its plant a new generator, new boilers and heater. L. E. Fisher is manager.

ANDERSON, IND.—A 310-hp Stirling boiler is now being installed in the municipal electric light plant. Charles Berry is superintendent.

COLUMBUS, IND.—The city clerk of Columbus has just made his report for 1906 relating to municipal lighting. According to the report the 173 electric street lamps cost the city $31.03 cents each during the year. The cost of each lamp was formerly estimated at $67.

CRAWFORDSVILLE, IND.—The Crawfordsville Electric Light & Power Company will soon make extensive improvements to its system soon. A new engine and dynamo will be installed and the lines overhauled. James R. Thomas is superintendent.

GOSHEN, IND.—The managers of the municipal electric light plant are contemplating changing the street lighting system to enclosed arc lamps. F. H. Shaffer is superintendent.

HUNTINGBURG,, IND.—A new engine direct connected to a 200-kw alternating-current generator is being installed in the electric lighting plant of the Missuer Bros. Company. August Miessuer is manager.

HUNTINGTON, IND.—The Huntington Light & Fuel Company is now installing a 350-hp Stirling boiler and has ordered a 450-kw generator to replace the 200-kw generator now in the plant. F. D. Townsend is superintendent.

MOORESVILLE, IND.—The Public Service Company has recently placed a contract with J. M. Larsen, of Chicago, Ill., for a 15-ton ice plant. B. V. Hubbard is manager.

MUNCIE, IND.—Earl Clevenger has been awarded the contract for the installation of the electric light plant at the new Children's Home building.

ROCKPORT, IND.—The Rockport Water Works Company is contemplating extending its power service. A. H. Kennedy is manager.

VEVAY, IND.—Contracts have been placed for a 150-hp Hamilton Corliss engine, one 100-kw generator and a 125-hp Brownell boiler for the municipal electric light and water works plant. Charles Holcroft is manager.

ALBIA, IA.—The City Council has granted a franchise to the Albia Electric Light & Power Company for the construction and operation of a street railway in the streets of the city. It is stated that the electric light plant has been sold to interests owning the Oskaloosa Light & Power Company.

CEDAR RAPIDS, IA.—Cedar Rapids & Iowa City Railway & Light Company is planning to increase the capacity of the engine room by 1,500 kw and enlarging and modernizing the entire boiler plant. The work will involve an expenditure of about $100,000. William G. Dows is manager.

DAVENPORT, IA.—The Tri-City Railway & Light Company is contemplating rebuilding its entire plant. A. G. Goldsmith is superintendent.

DAVENPORT, IA.—The Davenport Brick & Tile Company has submitted a proposition to the Town Council of Buffalo to furnish electricity for lighting the town.

FARRAGUT, IA.—The question of erecting a municipal electric lighting plant is now being agitated by the citizens of this place.

GILLESPIE, IA.—The Gillespie Electric Light, Heat & Power Company and the Benid Electric Light, Power & Telephone Company have been consolidated under the name of the United Electric Light & Power Company. The new company is capitalized at $30,000.

MANCHESTER, IA.—E. W. Hoag is contemplating putting in a day power circuit in connection with his electric light and power plant.

MOUNT AYR, IA.—The citizens are considering the question of the construction of a municipal electric light plant, and it is stated that an election will be held in the spring to vote on the proposition.

OSKALOOSA, IA.—The Oskaloosa Traction & Light Company will build 18 miles of single-phase interurban system and install new station equipment. A. B. Anderson is superintendent.

OTTUMWA, IA.—The Ottumwa Railway & Light Company is considering the construction of an interurban line.

TAMA, IA.—H. J. Ferguson, city clerk, writes that the citizens voted Feb. 7 to issue bonds for the construction of an electric light plant.

ATCHISON, KAN.—The Atchison Railway, Light & Power Company is contemplating building a new power house and installing 60-cycle, three-phase induction motors. John S. Hackstoff is manager.

CONCORDIA, KAN.—The Concordia Electric Light Company is contemplating increasing the capacity of its plant by the installation of a 150-hp high pressure boiler, an additional dynamo and a smaller engine, etc. H. M. Spalding is president and manager.

EL DORADO, KAN.—The El Dorado Electric & Refrigerating Company is contemplatng the installation of a 60-kw, 60-cycle, two-phase, 2,200-volt, direct-connected, high-speed outfit in its plant. C. D. Resler is manager.

KINGSLEY, KAN.—H. P. Ketelson, owner of the Kinsley Light & Power plant writes that he is now organizing a company with a capital of $25,000 to double the capacity of the plant and will also install a six-ton ice plant to be run in connection with the electric plant. When improvements are completed a 24-hour service will be established.

McPHERSON, KAN.—John Salthouse, manager of the McPherson Water & Electric Works, writes that the electric lines will be extended to the whole residence district of the city.

NORTONVILLE, KAN.—C. W. Buckingham, owner of the Nortonville Electric Light, Power & Heat plant is considering exchanging the present dynamo in the plant for one of larger capacity.

PEABODY, KAN.—L. J. Osborne, manager of the Peabody Light & Power Company informs us that the capital of the company has been increased for the purpose of adding a six-ton ice plant, a 40-hp Ideal engine and a 30-kw generator to its plant. The company will furnish a day power circuit for fans and for power purposes.

PITTSBURG, KAN.—A new boiler of 500 hp and engine are now being installed in the plant of the Home Light, Heat & Power Company. M. C. Kelly is manager.

BARDSTOWN, KY.—Plans are being prepared for building a street railway by the Bardstown Street Railway Company, 13 miles in length.

HOPKINSVILLE, KY.—The Hopkinsville Gas & Electric Company is changing its system from 133 to 60 cycles, and installing two Bullock generators having a combined capacity of 425 kw. D. J. Young is manager.

LOUISVILLE, KY.—The incorporators of the Kentucky Traction Company have turned over their franchise to construct a line from Louisville to Orel, to the Louisville Railway Company, and arrangements will soon be made by the latter company to construct the line.

MIDDLESBORO, KY.—The Commercial Club, of which Judge J. L. Manning is president, is interested in a project to build an electric railway from Middlesboro to Sterling, a distance of eight miles. Immediate steps will be taken to obtain the right of way.

UNIONTOWN, KY.—The Uniontown Electric Light Company will install another alternator and an additional boiler set in its plant. G. F. Cecil is manager.

CROWLEY, LA.—A. Durio, superintendent of the municipal water works and electric light plant, writes that a new boiler may be installed in the plant, and also 3,000 pounds of waterproof wire used on the lines.

FRANKLIN, LA.—Bids are wanted by the superintendent of the municipal electric light plant for enlarging the plant. John C. Lewis is mayor.

LAKE CHARLES, LA.—The Lake Charles Ice, Light & Water Works Company is considering the installation of 1,000-kw turbines, an alternating-current generator and other equipment. J. A. Landry is manager.

LAKE CHARLES, LA.—S. T. Woodring, general manager of the Calcasieu Long Leaf Lumber Company, writes that it is proposed to remodel the plant and expend about $200,000 in improvements. A new electric light plant, including dynamos, will be installed, two 78-in. x 20-ft. boilers will be placed, and a 750-gallon fire pump will be added to the plant and also a complete new system of water works will be constructed.

RUSTON, LA.—Extensive additions and improvements are contemplated for the city electric lighting plant which include the installation of a 150-kw, two-phase, 60-cycle, 2,200-volt, alternating-current generator belted to a L. & B. engine of 200 hp, an 85-kw, two-phase, 2,200-volt, 60-cycle alternator direct connected to an engine, and a 200-hp boiler, also a transformer for arc lamps for the street lighting system. R. H. Brooks is superintendent.

HAGERSTOWN, MD.—At the annual meeting of the Hagerstown Electric Railway Company, the proposition to increase the capital stock of the company from $200,000 to $1,000,000 was deferred.

AMESBURY, MASS.—The Amesbury Electric Light, Heat & Power Company is contemplating building an addition to the engine room, 60x40 feet. H. A. Sawyer is manager.

NORTH ABINGTON, MASS.—To meet the increasing demand for electricity the Electric Light & Power Company, of North Abington and Rockland, will install a new 400-hp generator.

NORWOOD, MASS.—The town of Norwood has entered into a contract with the Edison Electric Illuminating Company to furnish the town with electricity for municipal and commercial purposes for seven years. The electric energy will be delivered at the town line and be distributed by the town.

STOCKBRIDGE, MASS.—The Stockbridge Lighting Company expects to have its plant in operation by May 1. The company will furnish meters for all consumers of electricity and 16 cp lamps without charge. The schedule of charges for electricity has been fixed at 20 cents per kw-hour for lighting purposes, with a discount of 15 per cent on payments received within 10 days.

WEBSTER, MASS.—The Webster Electric Company has petitioned the Legislature for authority to extend its lines to Sturbridge for the purpose of furnishing electricity to the citizens of that town, and for permission to consolidate with the Southbridge Gas & Electric Company; and if the above petitions are granted to change its name to the Webster & Southbridge Gas & Electric Company, and also asks for authority to issue additional stock to finance the undertaking.

BATTLE CREEK, MICH.—Announcement is made that the Coldwater & Battle Creek Interurban road has been financed and that construction will commence in the spring. The cost of the road is estimated at $1,000,000.

CAMDEN, MICH.—L. S. Shannon has been granted a franchise to construct a street railway in this place.

SAUK RAPIDS, MICH.—It is reported that the City Council has decided to erect a new lighting system in this city.

AITKIN, MINN.—Dr. C. S. Kethan has petitioned for a franchise for an electric light plant.

ST. HILAIRE, MINN.—The Duluth Engineering Company, of Duluth (W. B. Patton, manager) writes that this company is preparing plans for an electric light and power plant to be constructed at St. Hilaire, using water power.

VIRGINIA, MINN.—The City Council has granted a franchise for a street railway to the Mesaba Traction Company, which is being promoted by F. B. Myers and associates, of Biwabik.

OMAHA, NEB.—The Omaha & Council Bluffs Street Railway Company has decided to build three new extensions to its street railway lines.

ELY, NEV.—A company, to be known as the Ely Electric Company, has petitioned the Commissioners of White Pine County for a franchise to construct an electric railway from the new town of Kimberly to the smelter site of the Nevada Consolidated Copper Company.

ALBANY, N. Y.—A mortgage on the property of the Economic Power & Construction Company, of Albany, for $250,000, has been filed at Albany, Feb. 1, and it is announced that the company intended to construct and operate plants in Buffalo, Rochester, Syracuse, Utica, Troy, Albany, Yonkers and New York City. The officers are: William K. McFarland, president, and Burt L. Jones, secretary. Mr. Jones was formerly manager of the George Electric Railway at Niagara Falls.

FLUSHING, N. Y.—C. B. J. Snyder, superintendent school buildings, New York City, awarded the contract on Feb. 4, for installing electric equipment in the buildings of the Parental School, Borough of Queens, to T. Frea. Jackson, Inc., 502 Columbus Avenue, New York City, for $37,340.

HUDSON, N. Y.—Bids will be received by the Common Council until Feb. 28 for supplying electricity for lighting the streets and public buildings of the city for a term of three or five years, beginning Jan. 6, 1908. William Wortman is city clerk.

MECHANICSVILLE, N. Y.—The Delaware & Hudson Company is reported to have purchased property north of Mechanicsville, on which it will erect a steam power plant to generate electricity for use of the Hudson Valley Railway and in part for the United Traction Company. The proposed plant will have a capacity of about 30,000 hp equipped with steam turbines. James McArthur, of Albany, is chief engineer.

MEDINA, N. Y.—The Common Council has granted a contract to the Swett Electric Light & Power Company for a term of five years. The price agreed upon is $70 per lamp for all-night service. The company also agrees to furnish electricity without charge for lighting of the fire house, the police station, village hall and school houses, the amount not to exceed $150 per month. The Niagara Electrical Transmission Company has not secured its franchise and it is doubtful if it will. The application has merely been referred to a committee of the board for investigation.

WATERTOWN, N. Y.—John R. Davidson, of Chicago, Ill., has been in this city and is reported to be looking into the advisability of constructing a power plant in this place.

APEX, N. C.—The question of constructing water works and an electric light plant is reported under consideration.

ASHEVILLE, N. C.—The Asheville Rapid Transit Company has been granted a franchise by the Board of Aldermen and will build a line to Weaverville, eight miles distant, and also a line to the top of Sunset Mountain.

LUMBERTON, N. C.—Bids are wanted until March 1 for $20,000 water bonds and $5,000 light bonds. For further information address R. C. Lawrence, town attorney.

WASHINGTON, N. C.—The Washington Investment Company has applied for a franchise for a 5-mile electric railway in the town.

WINSTON, N. C.—A bill has passed the State Legislature permitting the town of Winston and precincts of Forsyth County, to issue bonds for an electric railway from Winston to High Point, 26 miles distant.

CLEVELAND, OHIO.—According to the statement of W. J. Springborn, the local municipal light plant will show a profit of $1,553.33 as a result of the first year of its operation, since it was taken over when the village of Brooklyn was admitted as a portion of Cleveland. In making this reckoning, 10 per cent has been allowed for depreciation and 4 per cent for taxes. Mr. Springborn says that the lights cost the city $58.25 per lamp per year as against $69.72 charged by a private company. The new plant on the west side, with a capacity of 800 lamps, will soon be ready for operation.

MANSFIELD, OHIO.—At a recent meeting of the stockholders of the Mansfield & Wooster Interurban Railroad Company the capital stock was increased from $30,000 to $2,000,000.

NEW MADISON, OHIO.—The Council has taken up the question of supplying the town with electric lights and the proposition will be submitted to a vote of the people.

PORT CLINTON, OHIO.—A franchise has been granted to the Toledo, Port Clinton & Lakeside Railway Company to extend its lines.

SPRINGFIELD, OHIO.—The Springfield, Wilmington & Cincinnati Traction Company has increased its capital stock from $3,000,000 to $4,000,000.

TOLEDO, OHIO.—The Toledo & Western Railway Company has filed with the Secretary of State a certificate of the increase of its capital stock from $1,000,000 to $2,000,000.

TECUMSEH, OKLA.—The Tecumseh-Norman Traction Company will begin construction work as soon as the line is laid out. The power station will be located midway between Norman and Tecumseh. The officers of the company are: W. E. Powell, president; E. J. Dickeson, vice-president; George Weed, secretary; M. H. Tennison, treasurer and financial agent; J. H. Surber, superintendent, all of Tecumseh.

CORVALLIS, ORE.—The City Council has passed resolutions providing for the issue of $10,000 bonds, for the econstruction of an electric light plant.

ALEXANDRIA, PA.—The Alf retta Electric Street Railway Company, which was recently chartered, has been organized and the following officers elected: John Phillips, president; Henry Knode, vice-president; Samuel I. Spyker, secretary, and W. G. Kenaga, treasurer. The company has a capital stock of $75,000 and proposes to build a line from near Alexandria to Tyrone Forge.

DAWSON, PA.—Among the improvements made at the works of the Washington Coal & Coke Company during the past year, is a new steam and electric plant using the waste heat of the ovens for fuel for the boilers. The entire cost of improvements was about $225,000.

SCRANTON, PA.—The Scranton Railway Company is contemplating the erection of a plant, which will involve an expenditure of $300,000. A site has been purchased.

WILKESBARRE, PA.—The stockholders of the Wilkesbarre Gas & Electric Company on Jan. 28 elected R. L. Forrest, of Philadelphia, president, and P. F. Wickham, of New York, N. Y., secretary and treasurer, and decided to make improvements during the coming year to the power plant and the gas works, and to extend the system.

YORK, PA.—The construction of an electric railway between York and Delta by the way of Airyville, a distance of 20 miles, is being promoted by A. K. Frey, Samuel Fulton, Hugh Ross and others. The company will be known as the Red Lion & Airyville Traction Company and the road will be operated by power furnished from the McCall dam. A petition has been filed with the Borough Council of Red Lion for the right of way over certain streets in that borough.

YORK, PA.—The Wrightsville & York Street Railway Company has given notice at the State Department at Harrisburg of an increase in capital stock from $66,000 to $6,000,000 for the purpose of making extensions. The company will extend its line from Wrightsville over the Susquehanna River to Columbia.

WESTERLY, R. I.—The Westerly Connecticut Railway Company has been granted a franchise to extend its lines to Pleasant View.

CHARLESTON, S. C.—A bill has passed the lower house of the South Carolina Legislature to permit municipalities to sell water and electricity for lighting to residents living in the suburbs of such municipalities. The bill is not mandatory however.

UNION, S. C.—The Union Manufacturing & Power Company is considering a plan to offer to supply electricity to the town of Union, and to several large cotton mills. At the recent election for officers August W. Smith, of Spartanburg, was chosen president; H. C. Fleitman, of New York, secretary; E. Nicholson, vice-president, and Edwin W. Robertson, treasurer.

BONESTEEL, S. D.—The Town Board is being petitioned to call an election to vote on issuing bonds to the amount of $15,000 for water works, and an electric light plant.

CLIFTON, TENN.—A deal has just been closed whereby the Consolidated Telephone & Telegraph Company becomes the property of the W. C. Cole Telephone Company. The principal exchanges of the new company are Savannah, Waynesboro and Clifton, and the system will still be known as the Consolidated Telephone & Telegraph Company, with W. C. Cole, president; L. A. Raines, vice-president, and John U. Speer, secretary and treasurer.

BROWNSVILLE, TEX.—The Brownsville Water, Light & Power Company is arranging to make extensive improvements in its plant at a cost of $50,000. W. M. Ratcliffe is manager.

DENISON, TEX.—At a recent meeting of the stockholders of the Denison Light & Power Company it was decided to make extensive improvements to both the gas and electric plants at a cost of about $50,000.

FORT WORTH, TEX.—The Northern Texas Traction Company will soon make surveys of the proposed interurban line between Fort Worth and Cleburne.

FORT WORTH, TEX.—Plans are being prepared for the new power house of the Citizens' Light & Street Railway Company.

BRIGHAM CITY, UTAH.—A franchise has been granted to the Ogden & Northwestern Railroad Company by the Board of County Commissioners to construct an electric railway along the public highway between Hot Springs and Brigham. The company has also made application to the Mayor and Council of Willard and Brigham City for right to run through these towns.

MONTPELIER, VT.—Announcement has just been made public of the sale of the J. S. Viles Lighting & Power Company to the Consolidated Lighting Company. The price paid is said to be over $300,000. By the transaction the Consolidated Company acquires the plant at Middlesex Narrows and all the lighting and power contracts in Montpelier, Middlesex, Barre, Williamstown, East Barre, South Barre, Graniteville and Waterbury. The combined power of the two plants will give the Consolidated Company 6,600 water hp and 3,500 steam hp, or a total of 10,100 hp. The officers of the new company, it is announced, will be the same as those of the Consolidated: W. F. Davidson, of Port Huron, president; John C. Tomlinson, of New York, vice-president; A. D. Bennett, of New York, treasurer; J. E. Davidson, of Montpelier, secretary and general manager. The Consolidated Company will have its main office in Montpelier.

GATE CITY, VA.—Whited Brothers and C. D. Tate are considering the construction of an electric light plant.

NORFOLK, VA.—An electric plant to supply electricity for power and light is being installed at the plant of the Consumers' Brewing Company in this city.

RICHMOND, VA.—A resolution has been introduced in the City Council to authorize a $1,000,000 bond election for public utilities, including the erection of a municipal lighting plant. The resolution is now in the hands of the finance committee.

ROWLESBURG, VA.—Bids are being called for by the town of Rowlesburg for the construction of an electric light plant, to cost about $12,000. H. R. Hollis is town recorder.

TACOMA, WASH.—H. E. Salisch, an Eastern capitalist, who is president of the Salisch Lumber Company, is arranging for the construction of a large electrical plant on the Nisqually River. It is said that the plant will furnish power for the operation of the large railway car shops, to be built near Tacoma.

EAU CLAIRE, WIS.—The Ludington Telephone Company has increased its capital stock from $3,000 to $15,000.

MILWAUKEE, WIS.—The Wisconsin Electric Railway Company, which was recently incorporated, has changed its name to the Southern Wisconsin Traction & Light Company.

RACINE, WIS.—The Union Grove Telephone Company has increased its capital stock from $5,000 to $15,000.

CALGARY, CAN.—The proposition made by Messrs. Alexander & Budd to supply the city with electricity for power and light has been rejected and the city has made application to develop power at Kananaskis Falls.

FORT SASKATCHEWAN, CAN.—The Council has decided to install a central energy municipal telephone system and build a line to connect with the government long-distance line at Lloydminster. Address H. E. Daniel.

MOOSE JAW, CAN.—J. C. Jenner, city electrician, writes that the city contemplates the following extensions to the municipal electric lighting plant: One 1,000-kw, 60-cycle, two-phase generator, a prime mover of corresponding capacity and three 500-hp boilers and also considerable pole line extensions.

WINNIPEG, MAN.—Bids will be received by the Chairman Board of Control, until Feb. 25, for the construction of 24 miles of single-track tramway between Lac du Bonnet and Point du Bors, in connection with the electrical development. Specifications, plans, etc., on file at the Power Engineer's office, Carnegie Library Building, Winnipeg.

HAMILTON, ONT.—The Board of Works has decided to procure bids for 500 electric arc lamps, or their equivalent in Nernst or incandescent lamps.

MONTREAL, QUE.—The Canadian Pacific Railroad has purchased the Quebec Railway, Light & Power Company.

MONTREAL, QUE.—The City Council has decided to offer to the Montreal Light, Heat & Power Company an extension of contract for the supply of gas and electricity for 20 years, beginning May, 1910. The contract for gas is exclusive, but in the case of electricity it is provided that any company that cares to come in and compete with the Montreal Light, Heat & Power Company may do so on accepting the same conditions as are imposed on that company. The contract is meeting with much opposition, and will have to be approved of in a by-law to be adopted later.

Company Elections.

TORRINGTON, CONN.—At the annual meeting of the Torrington Electric Company the following officers were elected: George D. Workman, president; Frank M. Travis, treasurer; F. F. Fuessenich, secretary; the directors are: G. D. Workman, F. M. Travis, F. F. Fuessenich, John Workman, J. A. Doughty, Gideon H. Welch.

EATON, ILL.—At the annual meeting of the Eaton Telephone Company the following directors were elected: Judge Elam Fisher, L. D. Lesh, C. F. Brooke, C. B. Cokefair, C. E. Albright, Samuel Wolf and Dora Mitchell. The officers are: C. F. Brooke, president; L. D. Lesh, secretary, and Elam Fisher, treasurer.

KANSAS CITY, KAN.—At the annual meeting of the Missouri & Kansas Telephone Company, held Jan. 23, the present directors were re-elected, as follows: F. B. Fish and F. C. Phelps, of Boston; C. E. Yost, of Omaha; J. R. Mulane, M. A. Low and J. W. Gleed, of Topeka; J. S. Chick, J. F. Downing and C. S. Gleed, of Kansas City.

GREAT BARRINGTON, MASS.—At the annual meeting of the Great Barrington Electric Light Company held recently the following officers were elected: Frank Curtiss, president; P. A. Russell, vice-president and general manager; Clyde Parrish, superintendent.

GREENFIELD, MASS.—At the annual meeting of the Greenfield Electric Light & Power Company the following directors were chosen: F. O. Wells, W. M. Pratt, C. C. Dyer, William B. Allen, J. W. Stevens, Philip Cabot and Winthrop Coffin, of Boston. The officers are: J. W. Stevens, president; George W. Lawrence, treasurer, and Charles H. Keith, clerk.

NORTHFIELD, MINN.—At the annual meeting of the Northfield Telephone Company held Jan. 15 the following officers were elected: William Ebel, president; C. B. Crandall, vice-president; D. D. Turner, secretary; F. J. Wilcox, treasurer.

WILLMAR, MINN.—At the annual meeting of the Green Lake Telephone Company held Jan. 21 the following officers were elected: Oliver Larson, president; Charles Crevier, vice-president; William Olson, secretary, and S. C. Hillman, treasurer.

UTICA, N. Y.—At the annual meeting of the Utica Home Telephone Company the following officers were elected: Edgar B. Odell, president; H. F. Miller, vice-president; W. I. Taber, treasurer; C. H. Poole, secretary and manager.

CLEVELAND, OHIO.—At the annual meeting of the Lake Shore Electric Railway Company, held Jan. 15, the present board of directors was re-elected and at a subsequent meeting the board re-elected the present officers. The company has under contemplation an increase in the power house facilities at Fremont.

SANDUSKY, OHIO.—At a meeting of the directors of the Sandusky Telephone Company, held Jan. 28, the following officers were elected: George Feick, president; T. T. Morgan, vice-president; J. C. Hauser, secretary, and J. A. Geideman, treasurer. The company decided to expend $15,000 in improving the plant. Among the improvements contemplated is a new switchboard.

TOLEDO, OHIO.—At the annual meeting of the Toledo Railways & Light Company, held Jan. 17, the present board of directors and officers were re-elected.

ALLENTOWN, PA.—At the annual meeting of the Consolidated Telephone Companies of Pennsylvania, held in Allentown Jan. 15, the following directors were elected: George O. Albright, Allentown; R. E. Wright, Allentown; A. J. Brumbach, Reading; Thomas Daugherty, Allentown; Frank M. Green, Washington, D. C.; Wilson J. Hartzell, Allentown; J. P. Heifenstein, Shamokin; A. P. Trautwein, of Carbondale; George N. Reichard, of Wilkes-Barre; John R. Hendel, Reading; George R. Bedford, Wilkes-Barre; W. A. Lathrop, Philadelphia; C. D. Simpson, Scranton; I. A. Stearns, of Wilkes-Barre; C. W. Kline, Hazleton. The board organized by electing the following officers: Robert E. Wright, president; C. W. Kline, vice-president; C. M. W. Keck, secretary and treasurer, Allentown; Charles West, general superintendent.

BIRDSBORO, PA.—At the annual meeting of the Conestoga Telephone Company held recently the following officers were elected: John W. Slipp, of Birdsboro, president; Jacob Hartz, of Morgantown, vice-president; E. M. Zerr, of Geigertown, secretary; F. M. Brown, of Birdsboro, treasurer.

HARRISBURG, PA.—At the annual meeting of the Pennsylvania Telephone Company held recently the following officers were elected: A. R. Shellenberger, president; H. S. Huldekoper, vice-president; J. Heron Crosman, Jr., secretary and auditor; W. C. Fink, treasurer; L. H. Kinnard, general manager; Candor and Munson, Williamsport, general counsel.

POTTSTOWN, PA.—At the annual meeting of the stockholders of the Pottstown Light, Heat & Power Company, held recently, the following directors were elected: J. Allen Healy, Edgar S. Cook, Jacob C. Sotter, George N. Malsberger, H. C. Hitner, John W. Healy and Dr. John Davis. Samuel H. Fridy was re-elected secretary and treasurer. In the board reorganization J. Allen Healy was chosen president.

PROVIDENCE, R. I.—At the annual meeting of the stockholders of the Narragansett Electric Lighting Company, held recently, the following board of directors was elected: Marsden J. Perry, James M. Ripley, Fenner H. Peckham, William W. Douglas, Daniel A. Pierce, William A. Walton, Arthur H. Watson, George L. Shepley, H. Martin Brown, Samuel P. Colt, Howard O. Sturges, Samuel M. Nicholson, Robert W. Taft. The directors organized by electing the following officers to serve for the ensuing year: Marsden J. Perry, president and general manager; Arthur H. Watson, vice-president; Edwin A. Barrows, secretary and treasurer; Walter I. Barnes, assistant general manager.

BRISTOL, TENN.—At a special meeting of the stockholders of the Bristol Gas & Electric Company held recently the retiring directors were reelected. The board subsequently met and organized by electing C. B. Hobbs, president; B. L. Dulaney, vice-president; W. D. Turner, secretary, and C. H. St. John, treasurer.

BRADFORD, VT.—At the annual meeting of the Bradford Electric Lighting Company the following officers were elected: F. O. Kennedy, president; C. A. Prouty, first vice-president and manager; C. H. Curtis, second vice-president; Mrs. C. H. Curtis, secretary; Mrs. M. C. Brigham, treasurer.

SHERBROOKE, QUE.—At the annual meeting of the Sherbrooke Power, Light & Heat Company, the directors elected for the next year were: Hon. William White, F. P. Buck, A. G. Lomas, C. W. Cate, K.C., and M. Read. During the year the company has expended upward of $40,000 in the construction of a new power house and other improvements.

MONTREAL, QUE.—At the adjourned general meeting of the shareholders of the Mexican Light, Heat & Power Company, held Feb. 6 in this city, the following directors were elected for the ensuing year: Sir George A. Drummond, E. S. Clouston, J. H. Plummer, F. L. Wanklyn, F. S. Pearson, C. H. Cahan, A. Berliner, of Berlin; Arnold Ellert, of London; E. R. Wood, of Toronto. The directors elected the following officers: Sir George A. Drummond, president; J. H. Plummer, F. S. Pearson, F. L. Wanklyn, vice-presidents; C. H. Cahan, secretary-treasurer.

MONTREAL, QUE.—At the annual meeting of the Shawinigan Water & Power Company held Jan. 28 the following officers were elected: Hon. Robert Mackay, president; J. E. Alfred, vice-president, and Howard Murray, secretary.

New Industrial Companies.

THE ALBERGER PUMP COMPANY, of New York, N. Y., has been incorporated with a capital stock of $500,000. The directors are B. W. Pierson, G. Q. Palmer, New York, and L. R. Alberger, Greenwich, Conn.

THE EMPIRE ELECTRIC MANUFACTURING COMPANY, of Hartford, Conn., has been incorporated with a capital stock of $5,000 by James J. Murphy, Mark J. Hanlon and John L. Bonee, of Hartford, and Harry E. Propson, of Plainville.

THE HOYT & DEMALLIE, INC., of New York, N. Y., has been incorporated with a capital stock of $75,000 for the purpose of manufacturing electric vehicles. The directors are P. V. Hoyt, New York; J. M. Demallie, of New York, and C. A. Wilson, of Passaic, N. J.

THE NORTHERN CALIFORNIA ELECTRICAL WORKS has been organized at Redding, Cal., with W. W. Wheeler as consulting engineer, James H. Hoyle as business manager, and J. H. Getschell as manager.

THE STANDARD ELECTRIC & CHEMICAL COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $10,000, to manufacture and deal in electrical and chemical specialties. The incorporators are George Dierssen, George E. Fuller and Herbert Green.

New Incorporations.

MONTGOMERY, ALA.—The Tallapoosa Development Company has been incorporated with a capital of $50,000 by Hubert H. Ward, of Cleveland, Ohio. President, W. P. Putnam, of Detroit, Mich., vice-president, and Frank S. Ball, of Montgomery, secretary and treasurer.

DENVER, COL.—The Commonwealth Power & Electric Company has filed articles of incorporation with a capital stock of $2,000,000. The incorporators are Frank A. Maxwell and others.

BRIDGEPORT, CONN.—The Bridgeport, Danbury & New Milford Street Railway Company has applied to the State Legislature for a charter to construct and operate a street railroad between the towns named. The incorporators are William H. Marigold, Henry E. Reilly and John T. King, all of Bridgeport.

HARTFORD, CONN.—A resolution has been introduced to the state legislature by Mr. North, of East Windsor, incorporating the Hartford & East Windsor Street Railway Company for the purpose of constructing and operating a street railway. The capital stock of the company is to be $50,000, with power to increase it to $200,000. The incorporators are W. O. Burr, Normand F. Allen, Herbert C. Wells, Howard O. Allen and others.

WASHINGTON, D. C.—The Lyndhurst & Sherando Railroad Company, of this city, has been granted a charter by the State Corporation Commission. The company has a capital stock of $50,000 and the officers are Jackson H. Ralston, of Hyattsville, Md., president; John B. Sleman, Jr., secretary and treasurer. The road will be about six miles long.

BLOOMINGTON, ILL.—Articles of incorporation have been filed for the Corn Belt Traction Company to construct a line from Bloomington to Champaign. The capital stock of the company is $100,000 and the incorporators are William McKinley, Peter W. Moore and others.

CHICAGO, ILL.—Three new telephone companies have been chartered to do a long-distance telephone business, with Chicago as the center. The charter also grants the right to manufacture apparatus. The new companies are the Chicago, St. Louis & Western, Chicago, Milwaukee & Northern, and the Chicago, Indiana & Eastern long-distance telephone companies. The capital in each case is $5,000, and the incorporators are Conrad H. Poppenhausen, Joseph L. McNab and William G. Hamilton.

GALATIA, ILL.—The Galatia Independent Telephone Company has filed articles of incorporation with a capital stock of $1,065. The incorporators are S. D. Lockwood and others.

MORTON, ILL.—The Morton Heat, Light & Power Company has been incorporated, with a capital of $18,000. The incorporators are Moses B. and Frank Beyer, and others.

DUPONT, IND.—The Dupont & San Janeinto Telephone Company has been incorporated. The directors are W. D. Carson, C. Hoffman, Edward Ebble and Thomas Hall.

EVANSVILLE, IND.—Articles of incorporation have been filed with the Secretary of State for the Perry Hill Telephone Company with a capital stock of $1,000 by Fred W. Buent and others.

LYONS, IND.—The Lyons Co-operative Telephone Company has been incorporated with a capital stock of $10,000. The directors are John Davidson, G. W. Carpenter, W. D. Boyd and George Davidson.

NEW CASTLE, IND.—The New Castle Heat, Light & Power Company has been reorganized and will improve the electric plant and establish an artificial gas plant.

ATLANTIC, IA.—Articles of incorporation have been filed for the Atlantic, Northern & Southern Railroad Company, with a capital stock of $500,000. The company proposes to build an electric road north from Atlantic to Kimbleton and Manning and to Villisca. J. H. Simmons is president and J. Stier, secretary.

DAVENPORT, IA.—Articles of incorporation have been filed for the Independent Light & Power Company with a capital stock of $600,000 by A. E. Steffen and others.

PADUCAH, KY.—Articles of incorporation have been filed for the Paducah Southern Electric Railroad Company, with a capital stock of $50,000, by W. A. Martin and others.

SANDSTONE, MICH.—The Farmers' Mutual Telephone Company has been incorporated by E. J. Fenn and others.

MADISON, MINN.—The stockholders of the Madison Telephone Company have been organized with a capital stock of $50,000 by J. R. L. Swan and others.

WINONA, MINN.—The La Crosse & Winona Traction Company has filed articles of incorporation with a capital stock of $50,000, to build and operate interurban railroads. The officers are C. M. Morse, president; C. P. Crandall, vice-president; F. H. Sampson, secretary, and C. M. Green, treasurer.

CAMDEN, N. J.—The Susquehanna Railway, Light & Power Company has been incorporated with a capital stock of $100.000 by William Marriott Canby, Francis C. McCown, Sr., and J. J. Hope.

CHEEKTOWAGA, N. Y.—Articles of incorporation have been filed with the Secretary of State for the Cheektowaga Railway Company, with a capital stock of $75.000, for the purpose of building a street railway from Cheektowaga to Buffalo. The directors are: W. H. Kinch, C. E. Williams and H. H. Bennett, of Buffalo.

CLIFTON SPRINGS, N. Y.—The Rural Telephone Company, of Clifton Springs, has been incorporated with a capital stock of $4,000, by L. P. Conley and others.

ITHACA, N. Y.—Articles of incorporation have been filed for the Ithaca & Seneca Falls Interurban Railroad Company, with a capital of $1,000,000. The directors are: J. N. Hammond, S. J. Clary, of Seneca Falls, and Jacob Rothschild, of Ithaca.

JEWETT, N. Y.—Articles of incorporation have been filed with the Secretary of State by the Schoharie Valley Telephone Company. The capital is $2,000, and the directors are John Stickels, of Hunter, and N. Wesley Pross, John H. Gripman, George W. Dunham, Frank A. Ford, Frank C. Carr, Elmer Ploss, Samuel R. Lewis and Arthur Chatfield, of Jewett.

LONG BEACH, N. Y.—The Seashore Municipal Railroad Company has filed articles of incorporation with the Secretary of State, with a capital stock of $150,000. The company proposes to build an electric railroad from Hempstead to East Rockaway. The directors are: P. K. Ames, of Long Beach; M. H. Day, of Brooklyn, and H. D. Bristol, of Rockville Centre.

NEW YORK, N. Y.—The City & Suburban Subway Company has filed articles of incorporation with a capital stock of $250,000. The directors are H. W. Baird, Jr., and Thomas O'Hara, Yonkers; N. P. Stickney, Rochester.

NEW YORK, N. Y.—Articles of incorporation have been filed for the J. B. M. Electric Company with the Secretary of State with a capital stock of $30,000. The directors are: Alexander McGarry, J. E. P. Jepsom, of New York, N. Y.; G. R. Berger, of Newark, N. J.

NEW YORK, N. Y.—The Bowery Bay Railroad Company has filed articles of incorporation with a capital stock of $100,000 for the purpose of building a street railway from Woodside to Astoria, a distance of three miles. The directors are: Thomas Crimmins, New York; A. S. Williams and William Richardson, Long Island City.

NEW YORK, N. Y.—Articles of incorporation have been filed for the One Hundred and Forty-fifth Street Railway Company with the Secretary of State with a capital stock of $100,000 by M. P. Ryan, E. B. Gordon, and John Beaver, New York.

PHILMONT, N. Y.—Articles of incorporation have been filed for the Philmont Lighting & Power Company, with a capital stock of $20,000 by M. G. Thomas and others.

VESTAL CENTER, N. Y.—The Vestal Center Telephone Company has been incorporated with a capital stock of $2,000 by R. C. Adamson, Fred Barney and William Bogart and others.

RALEIGH, N. C.—The Union Power & Water Company has been chartered with a capital of $100,000. S. B. Shepherd and others are interested. The plant will be located in western North Carolina.

BEVERLY, OHIO.—The Beverly Telephone Company has been incorporated with a capital stock of $5,000, by J. A. Hart and others.

CINCINNATI, OHIO.—The Cincinnati, Reading & Middletown Traction Company has been chartered with a capital stock of $10,000 by Guy W. Mallon and others.

FULDA, OHIO.—Articles of incorporation have been filed for the Fulda Telephone Company by J. M. Holman and others.

GIRARD, OHIO.—The Girard Water & Light Company has been incorporated, with a capital of $100,000, by Chas. F. Brotherton, C. S. Sheldon, A. F. Faulkner, and others.

TOLEDO, OHIO.—The Toledo & Fremont Construction Company has been incorporated, with a capital stock of $10,000, to build a branch line of the Toledo & Port Clinton Electric Railroad from Oak Harbor to Fremont. The incorporators are George F. Peiter, C. N. Hawley, W. T. Kessler, Henry J. Rohrs and Foster E. Walker.

WAPAKONETA, OHIO.—The Minster, Loramie & Southern Railroad Company has been organized by citizens of this county for the purpose of operating an electric traction line from Minster to Versailles, a distance of 18 miles.

COOPERTOWN, OKLA.—The New State Telephone Company has been incorporated with a capital of $25,000. The incorporators are: W. C. Winworth, B. King, B. M. Rogers and V. Rakestraw, of Gotebo, and W. H. McKee, John Frank and L. L. Case, of Coopertown.

FREDERICK, OKLA.—The Tilman County Telephone Company has been incorporated with a capital stock of $20,000 by F. D. Stalford and others.

GUTHRIE, OKLA.—The Beaver & Cimarron Valley Telephone Company, of Zelma, Okla., and Englewood, Kan., has been incorporated, with a capital stock of $8,000. The incorporators are: A. J. Sands, Otto Barbey, of Zelma, Okla., and F. M. Wells, of Coin, and C. W. Newby, of Englewood.

GUYMON, OKLA.—The Guymon & Hansford Telephone Company, of this place, has been incorporated with a capital stock of $7,000. The incorporators are: B. Quinn, S. C. Taylor, D. F. Vincent, G. W. Baird and E. G. Summers.

OKARCHE, OKLA.—The Hoebing Telephone Company has been incorporated with a capital stock of $6,000. The incorporators are T. F. Hansom, John W. Thiems, of Calumet; John Hoebing, M. Wiemell, G. D. Lovell, Henry Frederick and Charles Thiems, of Okarche.

OKLAHOMA CITY, OKLA.—Articles of incorporation have been filed for the New State Electric Company with a capital stock of $30,000 by C. H. Leach, H. L. Rubholdt and others.

OKLAHOMA CITY, OKLA.—The El Dorado Telephone Company, of Oklahoma City, has been chartered to build and acquire telephone lines in Oklahoma and Texas. The incorporators are Duncan G. Smith, J. R. Keaton and M. R. Smith, of Oklahoma City; J. F. Woolbright and W. T. Perkins, of Quannah.

OKLAHOMA CITY, OKLA.—The Canadian Valley Telephone Company has been chartered with a capital stock of $5,000. The directors are B. Dougherty and others.

PECKHAM, OKLA.—The Air Line Mutual Telephone Company has been incorporated with a capital stock of $225 by Col. Lockwood, C. H. Cunningham, James E. Howarth and H. P. Maus, of Newkirk, and Frank Coffeen, of Peckham.

ZELMA, OKLA.—The Beaver & Cimarron Valley Telephone Company has been incorporated with a capital stock of $5,000 by A. J. Sands and others.

PORTLAND, ORE.—Articles of incorporation have been filed for the Mount Hood Railway & Power Company, with a capital stock of $5,000,000 by E. P. Clark, R. T. Linney, S. B. Cobb and C. W. Miller.

CHAMBERSBURG, PA.—The Colonial Street Railway Company has been chartered to build an electric railway from Graffensburg to Gettysburg, a distance of 13 miles. The capital stock is $200,000, and M. C. Kennedy, of Chambersburg, is president.

ELWOOD, PA.—A charter has been granted to the Peoples' Street Railway Company. The capital stock of the company is $12,000, and the incorporators are James Campbell, of Ingram, Pa.; Gomer L. Jenkins, Pittsburg, Pa.; Frank S. Christy, Crafton, and Frank Sheridan, Ingram.

HARRISVILLE, PA.—A charter has been granted to the Harrisville Telephone Company to build a telephone line in Butler, Venango and Mercer counties. The capital stock is $5,000. The director is W. A. McMillin.

HEIDELBERG, PA.—The Heidelberg Township Electric Light, Heat & Power Company has filed an application for a charter with the governor. The purpose of the company is to manufacture electricity for lighting, heating and power purposes in Heidelberg.

INDIANA, PA.—An application will be made to the Governor of Pennsylvania for a charter for a corporation to be known as the Punxsutawney, Indiana & Sagamore Street Railway Company. The incorporators are D. H. Clark, of Punxsutawney, and W. F. Elkins, J. A. Klingensmith, J. N. Lagan and J. D. Ake, of Indiana.

IRWIN, PA.—Application has been made by the Irwin-Herminie Electric Street Railway Company for a charter for the construction of an electric railway from Irwin to Herminie. The incorporators are: Holman R. Lynn, Clarence W. Scheck, A. E. Dubois, W. P. McClain and H. C. Miller. The line will be five miles in length. The company is capitalized at $35,000.

SUNBURY, PA.—The Sunbury & Trevorton Electric Railway Company has been chartered to build an electric railway from Sunbury to Plum Creek, a distance of 2½ miles. The company has a capital stock of $15,000. Monroe H. Kulp, of Shamokin, is president.

NEW CASTLE, PA.—Application for a charter has been published for the Beaver Falls, New Castle and Youngstown street car line, which indicates a merger of all the proposed interurban lines between here and the other two cities named. The right of way designated is from Beaver Falls to Hoytdale and Wampum to this city, with a branch from Wampum to Ellwood. The incorporators are: C. J. D. Stroheckler, Jordan Johnson, M. Bliss Dewey and George Nye.

READING, PA.—The Manufacturers' Electric Company, of Reading, has been formed, and will shortly apply for a charter. Jos. H. Tulane, of Philadelphia, is attorney for the company.

READING, PA.—The Twelfth & Thirteenth Streets Electric Railway Company has been incorporated with a capital stock of $30,000. The directors of the new company are: Walter A. Rigg, president; J. Milton Miller, Harry H. Riegel, Alvin Dunlap and James White.

SIMPSON, PA.—The Simpson Electric Light Company has been incorporated, with a capital of $20,000. The incorporators are Joseph W. Wilce, Louis E. Berg, Thomas Harner and others.

CHARLESTON, S. C.—A charter has been issued by the Secretary of State to the South Carolina Public Service Corporation, which is capitalized at $10,000,000. The officers are: Joseph J. Timms, president; Charles R. Van Etten, vice-president and general manager; John P. Bonney, secretary and treasurer.

HILLSDALE, WIS.—Articles of incorporation have been filed for the Hillsdale Western Telephone Company with a capital stock of $2,500, by M. W. Stephenson and others.

KARLSBORG, WIS.—Articles of incorporation have been filed with the Secretary of State for the Burnett County Telephone Company, with a capital stock of $1,000, by A. J. Myrland, Isaac Lundquist, P. J. Peterson and F. L. Peterson.

LA CROSSE, WIS.—The La Crosse & Winona Traction Company has been incorporated with a capital stock of $50,000. C. M. Morse is president.

MATTESON, WIS.—The Matteson Telephone Company has filed articles of incorporation with a capital stock of $6,000. The incorporators are L. A. Burgess and others.

OSHKOSH, WIS.—Articles of incorporation have been filed for the Oshkosh Electric Company with a capital stock of $10,000 by William R. Hill and others.

WAUPACA, WIS.—The Waupaca-Green Bay Railway Company has been chartered to build an electric railway 12 miles in length. The capital stock is $150,000 and the incorporators are A. G. W. Nelson and A. N. Penney.

MILWAUKEE, WIS.—The Badger Light Company has been incorporated with a capital stock of $5,000 by Jacob Hahn and others.

MILWAUKEE, WIS.—Articles of incorporation have been filed for the Wisconsin Electric Railway Company by W. D. Hickman, W. F. Adams and A. R. Denu. The company has a capital stock of $50,000.

CHATHAM, ONT.—The Iroquois Pipe Line Company has been incorporated with a capital of $100,600 to produce electricity for light, heat and power. The provisional directors include W. E. Woodruff, J. T. O'Keefe, Chatham, Ont.; H. D. Symmes, Niagara Falls, Ont.

NEW LISKEARD, ONT.—The Liskeard Light, Heat & Power Company has been incorporated with a capital of $200,000 to carry on a general electric light and power business. The incorporators are: K. Farah, J. Armstrong, J. J. Grille, New Liskeard, Ont.

OTTAWA, ONT.—The Dominion Power & Transmission Company has been incorporated here with a capital of $25,000,000. Mackenzie & Mann, of Toronto, are interested.

TORONTO, ONT.—The Cobalt Power Company has been incorporated here with a capital of $500,000 to produce electricity for light, heating and power purposes. The directors include: B. C. Beach, Haileybury, Ont.; A. Broder, Morrisburgh, Ont., and C. A. Beach, Winchester, Ont.

WATERFORD, ONT.—The Norfolk County Telephone Company has been incorporated with a capital of $40,000. The incorporators are: S. L. Squire, P. G. Pearce, Waterford, Ont.; H. Bartholomew, County of Norfolk, Ont.

QUEBEC, QUE.—George E. Amyot, Ltd., has been incorporated with a capital of $300,000, to produce electricity for light, heat and power. The incorporators are: G. E. Amyot, L. B. Bastien and A. E. Francoeur, all of Quebec City.

Legal.

ENFORCING PERFORMANCE OF CONTRACT TO SELL CORPORATE STOCK.—Where a valid contract to sell stock in a business corporation has been made and the party holding the stock refuses to live up to his agreement and transfer the stock, the purchaser has the right, through the medium of a court of equity, to compel the transfer to be made upon showing that the stock is not upon the market and that there is no available way of establishing the exact amount of damages caused by the breach. While this is the general rule there is one jurisdiction, namely, Pennsylvania, which entirely refuses to recognize the right to specific performance of a contract to sell corporate stock. Dennison vs. Keasby, Supreme Court of Missouri 98 S. W. Rep. 546.

RIGHT OF CONDEMNATION.—Advices from Helena, Mont., of February 6 state that a decision of far-reaching importance was handed down by the Supreme Court, in which it held that neither by the Constitution nor by the laws of the State is a foreign corporation authorized to exercise the right of eminent domain. The Helena Power Transmission Company, organized under the laws of New Jersey, brought suit to condemn lands belonging to A. N. Spratt, which are now submerged by the waters backed up by the company's dam across the Missouri. The suit was decided in favor of the company, and Spratt appealed, winning the case, as stated above. The court holds that the lands were wanted for a public use, but the company had no right to condemn them. The court says the decision is applicable only to foreign corporations of the respondent's character, the question not being considered with reference to any other class or character.

INJURY FROM CONTACT WITH GUY WIRE.—A lineman, sent out to remedy a defect in the telephone service of the company by which he was employed, was killed upon coming in contact with what was apparently a harmless guy wire. The guy wire was attached to the pole which he had ascended in the course of his work, and had become charged with a current dangerous to life by crossing a poorly insulated wire belonging to a municipal electric lighting plant. It appeared that the accident would not have happened but for the fact that the step of the telephone pole, upon which the lineman was standing, had attached to it a small hay wire which connected with the guy wire. But it was held that the negligence of the municipality was the proximate cause of the accident and that the municipality was liable in damages for the results flowing from its negligence. When a city embarks in the management of any utility for profit, it is liable, or not liable, by precisely the same rules which are applicable to private corporations or individuals conducting similar enterprises. Yazoo City vs. Birchett, Supreme Court of Mississippi, 42 So. Rep. 569.

DUTY OF TELEPHONE COMPANY TO MAINTAIN SUITABLE APPARATUS IN ITS EXCHANGE.—A telephone operator, while attending to calls for the connection of local subscribers with places out of town, was injured by receiving a severe electrical shock. In an action against the company for damages it was alleged that the company had negligently failed to provide a safe and suitable place of work for the plaintiff and had carelessly allowed its wires and appliances to remain out of order, although the plaintiff had reported to the chief operator the fact of having received slight shocks not before noticed. It was held that, on entering the defendant's employment, the plaintiff assumed the ordinary risks of nervous annoyance and irritation that might reasonably be connected with the performance of her duties, but that this did not include shocks from an electric current causing pronounced bodily prostration, even if the degree of voltage was not sufficiently high to imperil life. It was the duty of the defendant not only to provide suitable apparatus but to maintain it in a state of proper repair so that it could be properly operated. The objections interposed by the plaintiff to a verdict in favor of the defendant were sustained. Cahill vs. New England Telephone & Telegraph Company, Supreme Judicial Court of Massachusetts, 79 N. E. Rep. 821.

Educational.

CORNELL UNIVERSITY.—The Register for 1906-7 shows that the total number of regularly enrolled students in the University is 3,442, an increase of 57 over last year. The College of Architecture has an enrollment of 81 students; the College of Civil Engineering and the Sibley College of Mechanical Engineering now register 460 and 1,072, respectively. Only the one degree of M. E. is now awarded in Sibley College, though students are allowed to specialize during their senior years in electrical engineering, railway mechanical engineering, naval architecture, etc., for which special certificates are given.

WORCESTER POLYTECHNIC INSTITUTE.—The Thirty-seventh Annual Catalogue of the Worcester Polytechnic Institute shows that the total number of graduates in the classes that have been sent out reached 1,142 in June, 1906. This number is 51 per cent. of the total number of students enrolled in the 16 classes. At the present time there are 437 students in attendance at the Institute. It is expected that there will be a material increase in enrollment next year when the new electrical engineering building, which is now nearing completion, will afford adequate space and equipment for many more students in electrical engineering and will allow other departments to make use of the buildings now occupied by the department of electrical engineering.

Obituary.

MR. J. A. CREIGHTON.—The death is announced at Omaha, Neb., on February 7, of Count John A. Creighton. He was born in Licking county, Ohio, Oct. 15, 1831. When a youth he was employed by his elder brother Edward in the construction of a telegraph line from Cleveland to Toledo. Very soon, however, he made two trading trips to Denver. On his return from the second expedition he engaged in equipping wagon trains for their long journeys. About this time his brother had taken the contract for the construction of 700 miles of the Pacific Telegraph, the first line to be completed across the continent. John was made by his brother superintendent of all the work. He set out for Montana at the time of the gold fever there and when he returned to Omaha he was $33,000 richer. In 1866 he built a telegraph line of his own from Salt Lake to Virginia City, extending it in the next year 120 miles further to Helena. In 1868 he returned to reside permanently in Omaha. He amassed a great fortunee and devoted considerable of it to charitable and educational work. He was largely instrumental in establishing the Creighton University. In 1898 he built the John A. Creighton Medical College, and six years later founded the Edward Creighton Institute in memory of his brother. He was a devout Catholic, and after having been made a Knight of St. Gregory was, in 1895, created a Count of the Papal Court by Leo XIII.

Personal.

MR. H. C. SLEMIN, formerly of the engineering and sales departments of the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., has become advertising manager of the concern in place of Mr. J. O. Oliver, who shifts over to the sales organization.

LATEY & SLATER.—The firm of Latey & Slater, the formation of which was recently announced in these columns, has been appointed consulting electrical engineers to the Rapid Transit Commission of the city of New York.

MR. J. E. ALDRED, of Montreal, Canada, has been elected vice-president of the Shawinigan Water Power Company, of which he has been treasurer.

MR. G. F. ARCHER, consulting engineer and contractor, 39 Cortlandt Street, New York City, has just got out a descriptive "hanger," combining advertising and a map of the Panama Canal.

MR. E. M. JONES, who for the past five years has been in the employ of the General Electric Company, calling on the jobbing trade, has incorporated an electrical supply house under the name of Jones-Beach & Company, with headquarters at 204-206 North Fourth Street, Philadelphia.

MR. T. A. EDISON was born on February 11, 1847, and thus enters on his sixtieth year this week. He says that hereafter he will not work quite so hard, but will play a bit. He proposes to improve the phonograph and to perfect his new storage battery, as mere recreations. As to human knowledge, he believes that in 500 years we may begin to learn something and have a few facts on hand.

MR. E. J. WESSELS.—It may not be generally known that Mr. Edward J. Wessels, for several years managing director of the Lake Standard Air-Brake Company, who was known as the "father of surface car air-brakes," has for some years been engaged in life insurance expert work. He will move his office from 27 Pine Street to the West Street Building, on May 1, where he will be glad to meet old friends. Incidentally we are informed that Mr. Wessels is one of the largest insurance writers under contract with the Northwestern Mutual of Milwaukee.

MR. W. T. OVIATT, who has had general charge of the lighting department of the Connecticut Railway & Lighting Company, has been promoted by the Consolidated Railway Company to the position of general manager of all the gas, light and water plants connected with the Railway & Lighting Company's system. His headquarters will be in Waterbury. H. F. Reynolds, who was assistant to General Manager John E. Sewell of the Railway & Lighting Company, has been added to the staff of Vice-President Calvert Townley of the Consolidated Company, and he will perform a large part of the duties which formerly devolved upon Mr. Sewell. His headquarters will be in Bridgeport.

MR. A. J. MUNDY, of the submarine fog signal, returned this week from Germany by the "Amerika" of the Hamburg-American line. He said he was pleased with the reception that was given the device in Europe. "I superintended the installation of an apparatus on a submarine boat at Kiel," said Mr. Munday, "and the Antrim, a German cruiser, has had one placed on board. The German Government has ordered my invention installed on all light-ships on its coast, and the Dutch Government has done likewise. In Berlin I saw officials of the Admiralty, who had published a pamphlet highly recommending the device. So far only one lightship on the English coast, the Northwest, at Liverpool, has been so equipped. In France a bell has been placed at Sandettie, in the Channel, and the Lloyd, the North German Lloyd's tender at Cherbourg, is equipped with one. This boat is sent out to sea in a fog when a ship of the line is expected, and recently the Kaiser Wilhelm II heard her bell when fifteen miles away. The bell at Boston has been heard seventeen miles, however, but ordinarily six to ten miles is considered satisfactory. We have had applications for installation of the apparatus from every nation in the world that has a merchant marine. We are negotiating with Japan. So far the apparatus has been placed on upward of two hundred ships, twenty in Europe and many on this side."

Trade Publications.

COMBINATION SWITCH BOXES.—Folder No. 17 of the Chicago Fuse Wire & Mfg. Company, 166 South Clinton St., Chicago, Ill., is devoted to outlet combination switch boxes which are intended for finished house work.

TWIST DRILLS.—The Cleveland Twist Drill Company, Cleveland, Ohio, has issued as catalogue No. 32 a neatly prepared publication containing 171 pages illustrating, describing and giving a price-list of twist drills, reamers, sockets, bits, taps, counterbores, mills, cutters, mandrels, arbors, etc.

ELECTRIC ELEVATOR APPLIANCES.—A pamphlet recently issued by Scott F. Evans, Minneapolis, Minn., illustrates and describes automatic non-reversing friction stops for preventing backing of motors when the fuses blow, and friction clutch couplings for mounting on extensions of the motor shafts.

AUTOMATIC TIME SWITCHES.—An automatic time switch which has been designed with special reference to reliability and durability is treated at length in bulletin No. 4483 of the General Electric Company, Schenectady, N. Y.

TILE FOR WATER TUBE BOILERS.—The Warwick Company, Union and 22nd Street, Chicago, Ill., has issued an illustrated catalogue dealing with tiles for enveloping the water tubes of boilers for governing the draft area. It is claimed that the tiles increase the evaporation per pound of coal and prevent smoke.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently issued a folder describing the application of "Chloride" accumulators and "Exide" batteries to stationary gas or gasoline engines. The folder illustrates the system of battery ignition with these cells, both in stationary form, where charging current is available, and in portable form, where it is necessary to carry the batteries to a convenient charging source. Illustrations, dimensions, weights, capacities and prices of the two-plate types of "Chloride" accumulator and of the "Exide" sparking batteries are given, with a diagram of connections, and a concise explanation is included showing the method of determining the necessary resistance for cutting down the line voltage from an ordinary lighting circuit. The folder will be found useful to all operators of stationary engines, and will be forwarded from any of the sales offices of the company upon request.

BOILER SCALE.—Few people realize that one-eighth inch of scale in the tubes of a 200-hp water-tube boiler will fill two big wagons when taken out, and that this scale if left in the boiler decreases its steaming capacity about 30 per cent. These and many other facts about boiler scale are brought out in the new 48-page treatise "Boiler Scale and Its Removal," just issued by the Lagonda Manufacturing Company, of Springfield, O. Forty illustrations show how the tubes of any kind of water-tube boiler, economizer, evaporator or condenser can be cleaned with the Weinland mechanical cleaner or the Weinland direct motor cleaner. These cleaners are operated by steam engines, gas engines, electric motors, shafting, or powerful water motors. As an instance of the saving effected and wide range of use of these cleaners, their employment in an ice plant is mentioned. After operating for eight months only 34 tons of ice per day could be obtained. The tubes of the ammonia condenser were then cleaned with a direct motor cleaner, and the plant was immediately restored to a capacity of 48 tons per day. This book is being sent free to all who write for it.

ALTERNATING-CURRENT DATA.—General alternating-current data are given in Bulletin 74L just published by the Crocker-Wheeler Company, Ampere, N. J., entitled "Engine Type A. C. Generators." This gives the bulletin value for all who have to do with alternating current. A number of views are shown of plants where Crocker-Wheeler alternators are installed, and the bulletin also goes into details describing the design of generators developed by the Company, whose engineers began designing alternating-current machines about three years ago when the company had had fifteen years of highly successful experience in direct-current design and manufacture. They based their work upon the designs of the celebrated Swiss electrical engineers, Brown, Boveri & Cie, acting under license from the Swiss firm. They therefore entered the field unhampered by old designs, drawings and patterns, and were able to incorporate new and useful ideas in this class of machinery. The company met with instant recognition and has accomplished remarkable results especially in plants where the generators are driven by gas engines. One of the marked features of C-W alternators is their ability to operate in parallel. It was largely for this reason that the California Gas & Electric Corporation installed three 4,000 k.v.a. Crocker-Wheeler alternators in its San Francisco plant. These are the largest generators ever built for gas-engine-drive.

Business Notes.

THE STERLING ELECTRICAL & MANUFACTURING COMPANY, of Warren, Ohio, manufacturer of incandescent electric lamps, will build an addition to its factory in the spring.

THE PAJARO VALLEY MERCANTILE COMPANY, of Watsonville, Cal., has decided to engage in the business of manufacturing chandeliers, etc., and has purchased the electrical business of Mudgett & Grant.

THE AMERICAN CONDUIT MANUFACTURING COMPANY, Pittsburg, Pa., recently completed improvements at its factory which largely increased its output of rigid iron conduit. Its business has grown steadily and changes have been made to keep pace with the demand for its product.

THE REVOLUTE MACHINE COMPANY, 523 West 45th Street, New York, received telegraphic orders from the Baldwin Locomotive Works immediately following the fire which destroyed part of its shops, including the drafting department, for an outfit of Revolute blue-printing machines. The Baldwin Works had had one machine on trial, and the new blue-printing department will now be exclusively equipped with this type.

BRASS AND COPPER.—The unprecedented demand for brass and copper material has brought about a condition which works considerable hardship to those who find it necessary to get prompt deliveries. The mills are so overcrowded with orders and deliveries are so far behind that the consumer using this material has been forced to look around for some manufacturer who can deal with the conditions as they now exist. Stocks held in the various sections of the country have been found entirely inadequate to meet the demand, and those who formerly depended on these stocks have found it necessary to secure some larger and more complete source of supply. In this emergency the stock of the U. T. Hungerford Brass & Copper Company, of New York, has been of great value to the electrical trade. That enterprising concern began months ago to increase its stock and extend its lines, with the result that they are serving their customers with promptness and satisfaction. The stock in its New York warehouse consists of brass and copper in various forms for the electrical trade, consisting of rods, tubes, sheet and wire aggregating over 2,000,000 lbs. Switchboard manufacturers and others who use drawn copper bar, rectangular and round, will find here a complete assortment of standard sizes. The U. T. Hungerford Brass & Copper Company makes immediate shipment of all orders for stock material, and invites inquiries with regard to any points.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEB. 5, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N.Y.]

842,849. ELECTRIC HEATER; Arthur N. Anderson, Niagara Falls, N. Y. App. filed May 31, 1905. A flat iron is made with an interior chamber having transverse passages or grooves therein to receive resistance elements or spirals which are afterwards embedded in a plastic material filled in the grooves or passages.

842,852. ELECTRICAL CONTACT APPARATUS; James C. Boyd, New York, N. Y. App. filed Dec. 16, 1905. A form of spring impelled contact shoe or blade for the third rail of electric trains. Adapted to be used with two or more third rails at different levels with respecting to the running rails.

842,860. LUMINOUS SIGN; Paul L. Clark, New York, N. Y. App. filed May 23, 1905. An electrical sign designed to obtain the greatest possible illumination from an incandescent filament. Patentee has an arrangement of refractors adapted to receive the rays in an image corresponding to the outline of the character to be illuminated.

842,861. AUXILIARY FIRE ALARM BOX; Frederick W. Cole, Newton, Mass. App. filed Oct. 11, 1905. Relates to auxiliary fire alarm boxes and particularly aims to simplify the construction of the auxiliary actuating mechanism employed for releasing or otherwise operating the signal train.

842,867. BATTERY; Frank A. Decker, Philadelphia, Pa. App. filed July 14, 1906. A battery construction comprising a metal envelope having an auxiliary bottom of non-conducting material, a tube within said envelope, and a conduit exterior to and connected through said bottom with said tube.

842,875. X-RAY TUBE; Mylius Ehrhardt. Berlin, Germany. App. filed Oct. 18, 1904. In order to shield the operator and patient from accidental X-rays, patentee has a metallic lining consisting of metal powder or a thin sheet of metal secured to the outer surface of the tube.

842,910. WIRELESS COMMUNICATION; Greenleaf W. Pickard, Amesburg, Mass. App. filed Nov. 30, 1906. In systems of wireless communication, means for shielding the wave-intercepter from static discharges, which means consists of a conductor having impedance and non-inductive resistance connected to it.

842,911. ELECTRIC BELL; Henry E. Reeve, Brooklyn, N. Y. App. filed Oct. 4, 1905. Relates to details of construction of an electric bell, and particularly the contact or vibrator spring thereof, which is engaged by an extension of the armature adapted to make it operate in a positive manner.

842,918. TYPE PRINTING TELEGRAPH; Edwin J. Steljes, London, England. App. filed Apr. 17, 1905. A telegraph of that type having circularly arranged stops which are pressed inward in the path of a rotating element to make electrical contact. The operation of any stop, automatically repositions all the other stops previously depressed, by a mechanical connection.

842,930. RAILWAY SWITCH; Thomas K. Wilson, Chillicothe, O. App. filed Nov. 18, 1905. Provides means for operating a switch which is arranged to permit manual closing or opening of the switch or automatic closing of the switch by the movement of the train; has a mechanically arranged tappet depressed by the wheels in passing which closes a circuit.

842,941. INSULATOR; Walter G. Clark, New York. N. Y. App. filed Jan. 29, 1906. The combination with a wire-carrying insulator elongated in the direction of the wire strain or tension thereon, of bracing means extending into the insulator on the general line of said elongation.

842,942. WIRE-INSULATOR; Walter G. Clark, New York, N. Y. App. filed Jan. 29, 1906. The combination with an insulator having an overhanging upper edge, of wire-clamps adapted to be secured to a wire and engage the insulator beneath the said overhang.

842,945. BATTERY ELEMENT; Frank A. Decker, Philadelphia, Pa. App. filed Feb. 1, 1906. A molded and baked carbon primary battery-plate having a corrugated body provided with edge and interior bracing members, the interior bracing members being diagonally disposed to the corrugations.

842,950. BATTERY-CELL; Hugo Gernsback, New York, N. Y. App. filed June 28, 1906. The combination of a plurality of battery-cells having a spacing-block securing the cells near their tops, and means engaging the said block, for carrying the cells.

842,951. VENTILATION OF ELECTRIC MOTORS; George Gibbs, New York, N. Y. App. filed Oct. 25, 1906. In order to effectively supply air to the motors of a train, patentee has the swivel connections of the bogie-trucks hollow. These connections are supplied by an air pipe system.

842,957. ELECTRIC CAR AND LOCOMOTIVE; Coloman De Kando, Budapest, Austria-Hungary. App. filed May 12, 1904. Relates to motors having cranks with pitman connections to the driven mechanism. The journal boxes are made with a special bearing to receive the driving thrusts communicated by the crank shaft.

842,963. DYNAMO-ELECTRIC MACHINE; Marius C. A. Latour, Paris, France. App. filed Nov. 9, 1905. Details of the armature winding of an alternating-current generator.

842,966. METHOD OF OPERATING ELECTRIC MOTORS, GENERATORS, AND OTHER APPARATUS; Ralph D. Mershon, New York, N. Y. App. filed Feb. 1, 1904. The method of obtaining any desired wave frequency in an alternating current generator, which consists in producing the poles by shifting electric connections, in separated groups in which the angular distance between adjacent poles of opposite sign corresponds to the wave frequency desired.

842,971. WINDING MECHANISM FOR SELF-WINDING ELECTRIC CLOCKS; Henry W. Porter, Forestville, Conn. App. filed Sept. 4, 1906. Relates to driving mechanism of secondary clocks. The gear train is propelled by a weighted arm which is intermittently raised by an electromagnet.

842,978. MULTIPOLAR SERVICE SWITCH; Howard R. Sargent, Schenectady, N. Y. App. filed Sept. 3, 1901. Knife blade switches, including fuse connections, form part of the cover of a metallic box, so that the fuses can only be inserted when the switch is open and the circuit can only be completed when the box is closed.

843,033. FLUID PRESSURE REGULATOR; Walter J. Richards, Milwaukee, Wis. App. filed Apr. 7, 1904. A hand or pointer on the pressure gage moves into contact with a pair of adjustable stops or screws. These close the circuit of a pair of circuit controllers or contactors which operate the compressor motor.

843,039. TRAIN DESPATCHING SYSTEM; Charles E. Scribner, Jericho, Vt. App. filed July 9, 1906. Comprises a signal circuit extending from a train despatcher's station to a semaphore station and having means by which a test or repeat signal is transmitted to the despatcher's station by the actuation of a semaphore.

842,053. TELEPHONE-SWITCH; Klas Weman, Buffalo, N. Y. App. filed July 13, 1906. The combination of a casing comprising a shallow channel having an extension of greater depth, a set of contact-springs associated with said shallow channel and extending into said extension, and a lever for operating said springs.

843,054. INCANDESCENT ELECTRIC LAMP; Willis R. Whitney, Schenectady, N. Y. App. filed Oct. 31, 1904. The combination of a lamp-bulb having a re-entrant portion, small tubular extensions of said re-entrant portion, and seals for said tubular extensions each consisting of a cap of metal having a coefficient of expansion greater than that of the material of the lamp-bulb and tightly clasping the end of the tube.

843,058. FIRE ALARM; Gustaf A. Anderson, Kansas City, Kan., and Harvard O. Harpster, Kansas City, Mo. App. filed Jan. 30, 1906. A weight driven drum propels a gear train which is normally arrested by a magnetically displaced detent. The gear train has weighted arms which impinge against a bell when they are rotated.

843,070. SWITCH OPERATING MECHANISM; Theodore E. Button, Schenectady, N. Y. App. filed Oct. 11, 1904. A construction of large outdoor switch for heavy currents of high voltage. Plungers depend from massive arms into large oil tanks, and a spring tensioned by an electric motor propels the arms upward to break the circuits in the oil tanks.

843,078. TELEPHONE SYSTEM; Richard M. Eaton, Philadelphia, Pa. App. filed Mar. 30, 1904. Details of a party line telephone system.

843,155. MOTOR METER FOR ALTERNATING CURRENTS AND METHOD OF OPERATING THE SAME; Robert C. Lanphier, Springfield, Ill. App. filed Apr. 27, 1906. A motor meter of the mercury type for alternating currents. Provides a chamber containing mercury and an armature rotatable therein and an energizing field magnet caused to operate upon an alternating current and to register as a true watt-hour meter.

843,182. CIRCUIT CLOSING MECHANISM FOR INDICATORS ON CARS; Thomas W. Small, Cleveland. O. App. filed May 17, 1905. The trucks have depending arms with rollers which are impelled upward by projections adjacent to the track rails so as to close a signal or indicating circuit on the train.

843,186. TELEPHONE DICTATING MACHINE OR APPARATUS; Kelley M. Turner, New York, N. Y., and William F. H. Germer, Hoboken, N. J. App. filed Apr. 30, 1906. Dictating apparatus or "dictograph." Employs very sensitive transmitters and loud ear pieces combined with telephone sets and a switchboard in such a way that an office manager may dictate his letters to stenographers in adjacent rooms without the trouble of talking into a receiver. Has separate wire circuits by which the stenographers can interrupt to ask questions at the loud ear piece at any time so that their voice is audible throughout the manager's room.

843,245. TELEPHONE TRUNKING SYSTEM; Harry G. Webster, Chicago, Ill. App. filed Dec. 8, 1902. Diagram of cord circuits for a telephone exchange system having a toll line and a subscriber's line.

843,258. INSULATOR CLAMP; Walter G. Clark, Seattle, Wash. App. filed June 12, 1905. A clamp for holding wires in the groove or saddle of an insulator. The groove is undercut and the clamps slide into the groove so as to be locked against withdrawal from all directions when assembled on the wire.

843,259. INSULATOR; Walter G. Clark, Seattle, Wash. App. filed July 20, 1905. Relates to modifications of the above.

843,266. SYNCHRONIZER; William H. Freedman, Burlington, Vt. App. filed June 13, 1903. Relates to an apparatus for synchronizing polyphase or single-phase circuits, and particularly by which two-phase or single-phase generators may be quickly brought into synchronism before throwing them on the line.

843,267. FREQUENCY-METER; William H. Freedman, Burlington, Vt. App. filed Sept. 18, 1903. A frequency-meter for alternating-current circuits comprising a fixed and a movable element, which carry rotating magnetic fields which interact on each other, both elements having energizing coils, and means for connecting the circuits of said coils in parallel to the terminals of the circuit to be measured, the constants of said circuits differing from one another.

843,270. CIRCUIT CATCHING DEVICE AND ELECTRICAL SYSTEM FOR USE IN CONJUNCTION WITH THE SAME; Albert H. Graves, Chicago. Ill. App. filed May 8, 1903. Relates to improvements in circuit catching devices and electrical systems for use in conjunction with the same. Provides means by which a normally open circuit may be made to close itself and be retained in closed position at the will of the operator. Utilizes a condenser at the distant station charged by the line voltage.

843,276. AUTOMATIC ELECTRIC SWITCH; William F. Irish, East Orange, N. J. App. filed July 16, 1904. The float arm has a cam groove or orifice which engages a pin on a switch lever so as to move the switch by an abrupt movement into circuit closing or circuit opening relation after a predetermined movement of the float lever.

843,281. LAMP SOCKET FOR INCANDESCENT LAMPS; Charles M. Keier and Edwin W. Keier, Toledo, O. App. filed July 11, 1904. A switch for an incandescent lamp designed to obtain a double point break. The turn button depresses a plate which has a pair of arms depressed into engagement with the two clips or contacts of the switch. One of these contacts constitutes the central stud terminal of the lamp.

843,283. ELECTRIC SIGNAL; Charles L. Krum, Chicago, Ill. App. filed Jan. 10, 1903. Relates to audible electric signals used in connection with telephones and seeks to provide a simple construction which may be easily adjusted and kept in order. Details of construction.

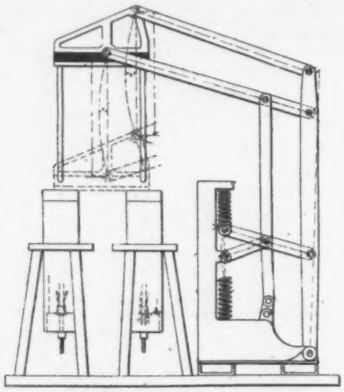
843,286. POWER TRANSMISSION MECHANISM; Robert H. Little, Chicago. Ill. App. filed Dec. 11, 1905. A means whereby loads may be intermittently operated particularly where the load is operated

by a load bearing rotatable shaft. Particularly adapted for the operation of rheostats on commutating switches of "flashers."

843,287. ELECTRIC MOTOR; Andrew T. MacCoy, Dover, Mass. App. filed Mar. 15, 1905. A small motor for dental and similar purposes having a plurality of U-shaped iron parts which are assembled upon a magnet winding so as to produce inwardly directed poles which are intermittently energized to attract the projecting faces of a sheet metal armature.

843,296. TELEPHONE RELAY OR REPEATER; Albert L. Parcelle, Boston, Mass. App. filed Oct. 12, 1900. Has a two-part ring-like magnet, one section of which is permanently magnetic and the other of which is of soft iron and a transmitter circuit including a coil about the soft iron section.

843,310. INCANDESCENT LAMP SOCKET; George B. Thomas and Gilbert W. Goodridge, Bridgeport, Conn. App. filed July 5, 1906.



843,070.—Switch Operating Mechanism.

Details of a bayonet fastening for the two-part casing of an incandescent lamp. Has embossed portions which prevent the accidental displacement of the casing parts.

843,316. ATTACHING MEANS FOR ELECTRIC LAMPS; Earl G. Wilson, Morrow, and William B. Goodwin, Columbus, O. App. filed Dec. 4, 1905. The lamp has a socket or receptacle with a rubber suction cup so that it may be stuck on the wall or any smooth surface for temporary use.

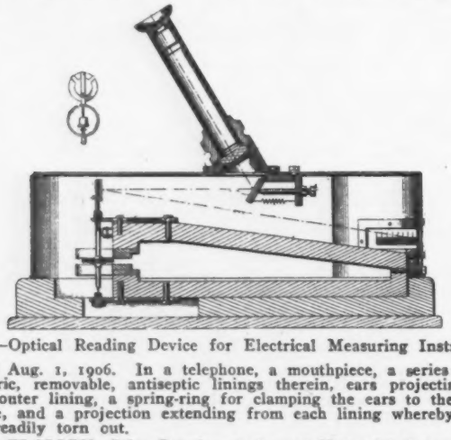
843,321. ELECTROPLATING APPARATUS; Herman R. Boissier, Great Neck, N. Y. App. filed Nov. 25, 1905. The combination with a tank and means for supplying current thereto, of a shaft movable in a conical path within said tank, and a receptacle for the articles to be plated carried by said shaft.

843,327. AUTOMATIC CIRCUIT CLOSER; Leandre Charbonneau, Woonsocket, R. I. App. filed Nov. 21, 1906. Thermostat, including a strip of fusible metal which normally restrains a weighted arm against circuit closing movement.

843,329. INTERCOMMUNICATING TELEPHONE SYSTEM; William W. Dean, Chicago, Ill. App. filed June 15, 1903. In an intercommunicating system, a plurality of lines, the combination with a common battery, of a separate metallic talking circuit for each line, an individual signaling-wire for each line, and a common signaling-wire for all of the lines, substantially as described.

843,354. ELECTRODE FOR THERAPEUTIC USE, &c.; Everett T. Nealey, Bangor, Me. App. filed May 14, 1906. In order to keep the wooden electrodes of a therapeutic apparatus constantly moist as is required, patentee has them in constant communication with tubes which are filled with water or suitable liquid. These tubes also furnish the current conducting means.

843,362. ATTACHMENT FOR MOUTHPIECES OF TELEPHONE-TRANSMITTERS; William C. Plank, Las Flores, Mexico. App.



843,414.—Optical Reading Device for Electrical Measuring Instruments.

filed Aug. 1, 1906. In a telephone, a mouthpiece, a series of concentric, removable, antiseptic linings therein, ears projecting from the outer lining, a spring-ring for clamping the ears to the mouthpiece, and a projection extending from each lining whereby it may be readily torn out.

843,373. TROLLEY; John Struth and Conrad Holzapfel, Primrose, Pa. App. filed June 23, 1906. In order to keep the trolley on the wire, patentee has a pair of projecting arms on the harp which are spring positioned so as to be capable of separating when passing hangers, etc.

843,414. OPTICAL READING DEVICE FOR ELECTRICAL MEASURING INSTRUMENTS; Edwin F. Northrup, Philadelphia, Pa. App. filed March 27, 1906. A box contains the essential parts of a D'Arsonval galvanometer. The reflected image of the scale is focused on the cross hairs of a microscope which projects diagonally from the top of the box.

843,415. ELECTRICAL SYNCHRONISM; Edwin F. Northrup, Philadelphia, Pa. App. filed Oct. 18, 1906. The combination with one or more coils arranged to develop a periodically-varying electric current, of a circuit including said coils and a synchronizing ohmic resistance, means to vary the load of said resistance on said coils at regular intervals the natural frequency of which is less than the natural frequency of the said electric current, the latter being damped down to synchronism with the period of said load-varying means by the load of said resistance.

843,425. INCANDESCENT LAMP SOCKET; Fredrick Wunderlich, Swissvale, Pa. App. filed Nov. 28, 1906. The threaded shell of the incandescent lamp has embossed portions thereon which co-operate with the receptacle to prevent its removal. The lamp is capable of being removed by special manipulation when it is broken.

843,441. ELECTRIC INSOLE; Henry O. Can Dee, Syracuse, N. Y. App. filed Feb. 7, 1906. The inner sole for a shoe having the usual copper and zinc elements and also having a resilient heel so as to provide a spring support for the wearer.

843,445. TROLLEY CONTROLLING DEVICE; Jonathan Dale, Kinston, N. C., and Harvey Le Roy Dale, Newport News, Va. App. filed July 9, 1906. The trolley reel is connected by a clutch to a retrieving spring or drum and this clutch is thrown in case of undue unwinding movement of the reel.

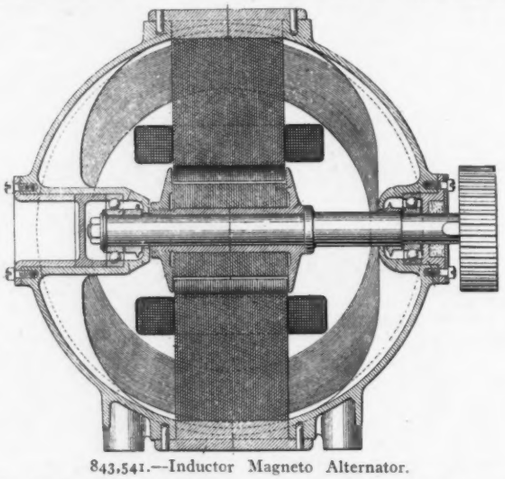
843,473. John N. Makley, Edward F. Manett, and Frank M. Dannelly, Dallas, Tex. App. filed July 17, 1906. An electrically operated switch tongue throwing mechanism. Includes a special construction of motor having a vertical shaft and an annular gear with a pitman connection to the switch point.

843,489. PARALLEL RUNNING OF DYNAMO MACHINES; Charles A. Parsons and George G. Stoney, Newcastle-upon-Tyne, England. App. filed July 25, 1905. In combination, a plurality of continuous-current dynamo-machines having series coils compensating for armature reaction; and an equalizing-wire cross-connecting certain points within the compensating windings of the two machines, as and for the purpose described.

843,508. PRINTING TELEGRAPH; James D. White, London, England. App. filed July 3, 1906. The type wheel of a printing telegraph is held by a pulley system so as to move into printing relation when any one of a number of selector magnets is energized.

843,515. PROCESS FOR ELECTRICALLY WELDING THE LONGITUDINAL JOINTS IN TUBULAR OBJECTS; Emil Bier, London, England. App. filed Sept. 10, 1906. For the purpose of welding together the edges or seams of boiler plates, etc., patentee has a transformer coil which is arranged to be placed about the seam to be welded so as to impel a current therethrough to heat the same.

843,520. ELECTRIC TRAM SYSTEM; Orrin J. Davy, Washington, D. C. App. filed Nov. 5, 1906. Construction of car and diagram of



843,541.—Inductor Magneto Alternator.

circuits for a telpherage or tram car system having a depending trolley pole to engage a conductor beneath the track. The car is controlled by a handle at the seat of the operator.

843,533. INDUCTION VAPOR OR GAS ELECTRIC LAMP; Peter C. Hewitt, New York, N. Y. App. filed Apr. 18, 1900. A vapor or gas device having an inclosing chamber, a primary exciting-coil, the vapor or gas constituting a secondary circuit for said primary, the vapor or gas having such quality as to be traversed by induced electric currents and absorb practically all the energy from an oscillatory circuit in the first oscillation, and means for transmitting rapidly-varying electric currents through the primary, thereby rendering the secondary luminous.

843,534. METHOD OF PRODUCING ELECTRIC LIGHT; Peter C. Hewitt, New York, N. Y. App. filed Sept. 28, 1900. The method of operating a vapor-lamp by electromagnetic induction, which method consists in subjecting said lamp to a rapidly-varying magnetic field of such rapidity of variation and of such total energy as will cause the inclosed vapor to become a low-resistance vapor-conductor.

843,541. INDUCTOR MAGNETO ALTERNATOR; Leon J. Le Pontois, New Rochelle, N. Y. App. filed Dec. 11, 1905. Magneto generator designed to generate alternating currents for the ignition of combustible mixtures in internal combustion engines either by the make and break system or the jump spark system. Provides means for rectifying the alternating current.

843,549. RECEPTACLE FOR ELEMENTS; Heinrich P. R. L. Porscke and Gustav A. Wedekind, Hamburg, Germany. App. filed July 25, 1904. The battery-container electrode formed of heat-resisting conductive material and having walls serving as a support for hard coherent copper oxide material.

843,550. ELECTRIC SIGNALING SYSTEM; Frank W. Prentice, Chicago, Ill. App. filed Mar. 24, 1906. Cab and block signal system employing Hertzian waves for controlling signaling devices upon the car or engine to indicate the condition of the right-of-way with respect to the other trains.

843,553. FUSE BOX; Charles A. Rolfe, Rochester, N. Y. App. filed Apr. 19, 1905. A construction of fuse box having fusible elements enclosed in insulating tubes or shields open at the top so as to be readily inserted.